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Stock assessment for British Columbia herring in 2002 and forecasts of the potential catch in 2003

Évaluation des stocks de hareng de la Colombie-Britannique pour 2002 et prévisions des prises potentielles en 2003

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ABSTRACT

Herring stock abundance in British Columbia waters was assessed for 2002 and forecasts were made for 2003 using an age structured assessment model for the major stock assessment regions and an escapement model for the minor stocks in Areas 2W and 27. These models have been applied to assess herring abundance since 1984. As in the 2001 assessment, changes to the analytical model were introduced to account for temporal change in the spawn index. A fixed spawn conversion or catchability factor was applied for the dive survey era beginning in 1988 and a free fitted parameter was estimated for the earlier surface survey period. All available biological data on total harvest, spawn deposition, and age and size composition of the spawning runs were used to determine current abundance levels. No significant problems were evident in the extent and comprehensiveness of the data collections. All data were included in and summarized from an Access database which differ slightly from earlier procedures. Impacts on estimated run size was shown to be minor. Coastwide, the estimated pre-fishery stock biomass for all assessment regions in 2002 was 233,000 tonnes based on the age-structured model which represents a 21% increase over the 2001 abundance level. This increase reflects increased abundance in the south coast stocks particularly the Strait of Georgia. However, abundance in the Queen Charlotte Islands is depressed and fisheries should be closed for conservation considerations.

The estimated harvestable surplus in 2003 (20% of the 2002 forecast herring run) based on forecast abundance to the five assessment regions is 41,530 tonnes for the B.C. coast assuming average recruitment to all areas. However, since consensus on stock levels for each assessment region may change as a result of PSARC review of these data, forecast run sizes, and harvestable surpluses, are subject to change.

RÉSUMÉ

On a utilisé un modèle d'évaluation structuré par âge pour déterminer l'abondance du hareng chez les principaux stocks de la Colombie-Britannique en 2002 et faire des prévisions pour 2003, et un modèle d'échappement pour les petits stocks des zones 2W et 27. Ces modèles sont utilisés à cette fin depuis 1984. Comme pour l'évaluation de 2001, des changements ont été apportés au modèle analytique de sorte à tenir compte du changement temporel dans l'indice de frai. Un facteur fixe de conversion ou de capturabilité du frai a été appliqué à la série de données recueillies en plongée depuis 1988 et un paramètre librement ajusté a été estimé pour la période précédente de relevés en surface. Toutes les données biologiques disponibles sur les prises totales, la ponte et la composition par âge et par taille des stocks reproducteurs ont été utilisées pour déterminer les niveaux d'abondance actuels. Aucune problème important n'était évident dans l'étendue et la représentativité des séries de données. Toutes les données ont été extraites d'une base de données Access, puis résumées, ce qui diffère légèrement des procédures antérieures, mais l'incidence de ceci sur la taille des stocks reproducteurs s'est révélée minime. À l'échelle de la côte, la biomasse estimative des stocks avant la pêche en 2002 pour toutes les zones évaluées s'élevait à 233 000 t d'après le modèle structuré par âge, ce qui représente une augmentation de 21 % par rapport au niveau d'abondance de 2001. Cette augmentation reflète un accroissement de l'abondance chez les stocks de la côte sud, en particulier celui du détroit de Georgia. Par contre, l'abondance chez le stock des îles de la Reine-Charlotte a fléchi et les pêches devraient être interdites pour des raisons de conservation.

Pour l'ensemble de la côte de la Colombie-Britannique, l'excédent pêchable en 2003 (20 % du nombre prévu de reproducteurs en 2002) estimé d'après l'abondance prévue dans les cinq régions d'évaluation se chiffre à 41 530 t dans l'hypothèse d'un recrutement moyen dans toutes les zones. Toutefois, étant donné que l'on pourrait changer d'idée quant au niveau du stock dans chaque zone d'évaluation suite à un examen des données par le CEESP, la taille prévue des stocks reproducteurs et les excédents pêchables pourraient changer.

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1. INTRODUCTION

Herring have been one of the most important components of the British Columbia commercial fishery over the past century with catch records dating from 1877. The fishery has evolved from a dry salted product in the early 1900s, to a reduction fishery in the 1930s that collapsed in the late 1960s as a result of environmental change and excessive harvesting. After a four year closure the current roe fishery began in 1972. Roe fisheries occur just prior to spawning when the fish are highly aggregated and very vulnerable to exploitation. Since 1983, herring roe fisheries have been managed with a fixed quota system. Under this system, harvest levels are determined prior to the season based on a fixed percentage (20%) of forecast stock size. In addition, threshold biomass or Cutoff levels were introduced in 1985 to restrict harvest during periods of reduced abundance.

In previous reports, stock assessments were presented for two analytical models developed explicitly for British Columbia herring populations: (1) a modification of the escapement model described by Schweigert and Stocker (1988); and (2) a modification of the age-structured model described by Fournier and Archibald (1982). In this report, the age-structured model is adopted as the primary assessment tool and escapement model estimates are provided only for minor stocks in Areas 2W and 27. Stock abundance estimates are developed for the period 1951-2002 and forecast pre-spawning abundance for the 2003 season are presented. Forecasts of upcoming run size are based on the combination of estimates of surviving repeat spawners and newly recruiting spawners which are presented as poor, average, and good, based on historic recruitment levels.

1.1. STOCK CONSIDERATIONS

The stock concept used for managing British Columbia herring is based on current knowledge of stock structure that is necessarily incomplete. Given incomplete knowledge of population structure, it is prudent to manage fisheries to ensure maintenance of the greatest potential biological diversity in all regions. Additionally, stock forecasts for smaller geographic regions than those used in the current assessments are not accurate enough for fisheries management. Therefore, fisheries should continue to focus on the major aggregations within each assessment region to minimize the potential over-exploitation of any smaller, spatially discrete spawning groups. In the 2002 spawning season, the research study using a combination of coded wire tagging and micro-satellite DNA analysis to further investigate stock structure of British Columbia herring was continued. Preliminary results of these studies are presented in separate reports (Schweigert and Flostrand 2000, Flostrand and Schweigert 2002, Beacham et al. 2001).

The stock groupings used for the current assessments are identical to those used since 1993 (Fig. 1.). The Queen Charlotte Islands stock assessment region includes most of Statistical Area 2E, spanning from Cumshewa Inlet in the north to Louscoone Inlet in the south. The Prince Rupert District stock assessment region encompasses Statistical Areas 3 to 5. The Central Coast assessment region separates the major migratory stocks from the minor spawning populations in the mainland inlets. The Central Coast assessment region includes Statistical Area 7 plus Kitasu Bay in Area 6 and Kwakshua Channel in Area 8. The Strait of Georgia stock assessment region includes all of Statistical Areas 14 to 19, 28, 29, and Deepwater Bay and Okisollo Channel in Area 13. The west coast of Vancouver Island assessment region encompasses Statistical Areas 23 to 25. Haist and Rosenfeld (1988) outline current geographical stock boundaries.

Abundance estimates are not presented for other areas outside of the major assessment regions that may support additional small herring runs, because both the spawn survey and catch data are incomplete for many of these areas. Therefore, presentation of stock estimates could lead to erroneous conclusions regarding either absolute abundance or stock trends. Recent attempts to conduct a complete age-structured assessment for Areas 2W and 27 have been unsuccessful because of incomplete data. An escapement model estimate of current stock abundance is available for these areas but no forecast of abundance in the coming year is possible.

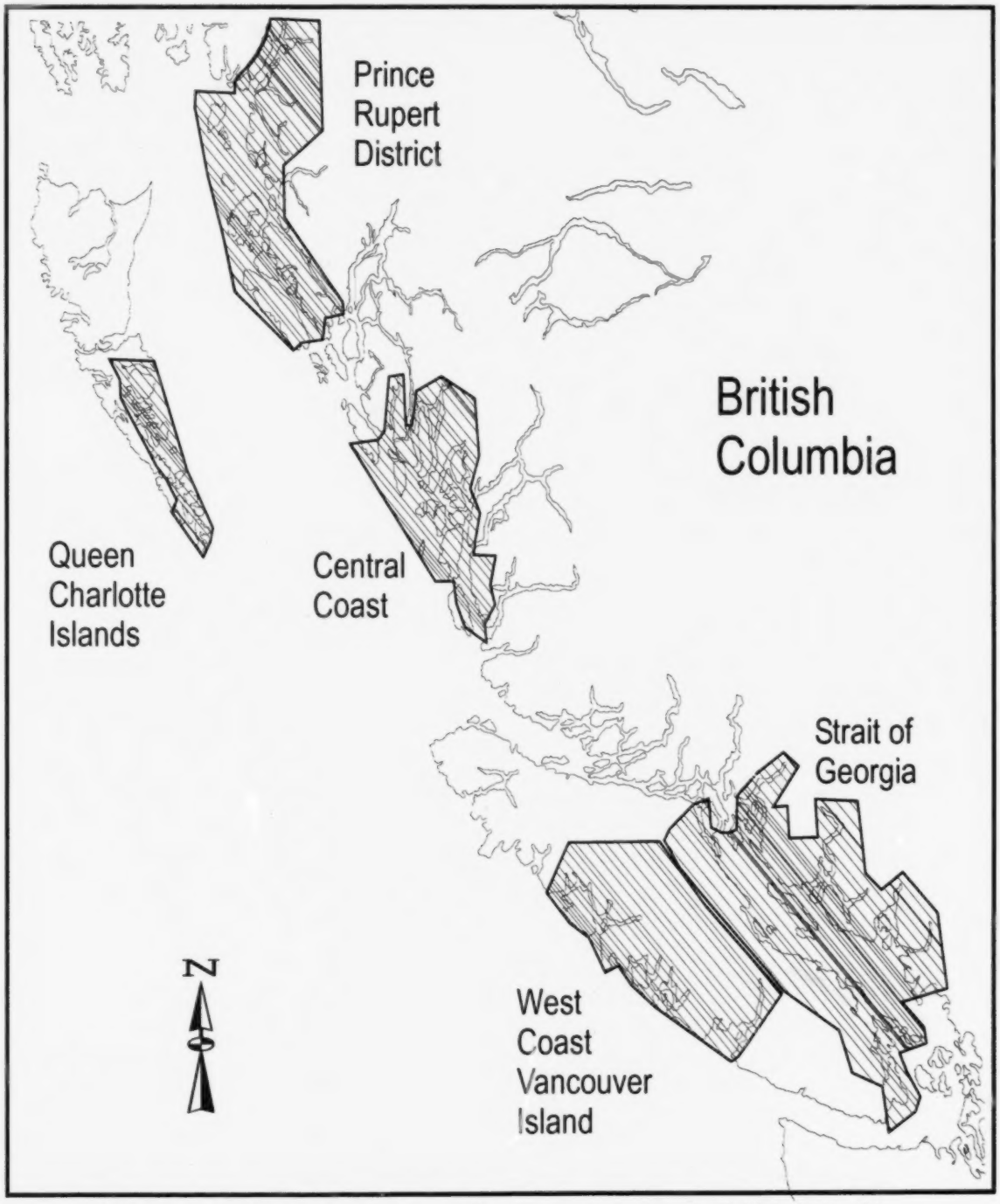

Figure 1. Pacific herring major stock assessment regions in British Columbia.

1.2. DATA BASE

The primary data sources for the stock assessments are spawn survey data, commercial catch landing data, and age composition data from biological samples of commercial fishery, pre-fishery charter, and research catches. These data are available in an Access database for the period 1951 to 2002. This time span includes the reduction fishery period to 1968 and the subsequent roe fishery period that began in 1972.

Of the three data sets, the spawn data contain the largest measurement errors. While the quality of spawn surveys has generally improved over the 52 year span of these data, due to increased effort and better quality control of the surveys, there are occasional problems with equipment and weather which may hamper data completeness or accuracy in some years. The consistent observations made during all years of surveys are the total length, the average width, and a measure of egg density for each spawning site. Since 1987 an increasing number of egg beds have been assessed using Scuba rather than traditional surface survey methods. We assume all surveys provide accurate estimates of spawn bed width and egg density. These data have been used in developing the spawn index where available. All major herring spawning beds were surveyed in 2002. Many of the minor spawning beds outside the assessment areas were also surveyed by Scuba in 2002.

Catch information was obtained from landing slips or monitoring of plant offload data. Historically, landing slip data were summed by fishery season (seasons run from July 1 to June 30). Beginning in 1997/98 season, roe catch figures are based on verified plant offload weights, a result of the introduction of the individual vessel quota ('pool fishery') system for all fisheries except the Strait of Georgia and Prince Rupert gillnet fisheries. Since the 1998/99 season, verified plant offload weights are available for all food and roe fisheries coastwide. The spawn-on-kelp (SOK) fishery includes a total of 46 licensed operators who pond a substantial quantity of herring of which an unknown quantity dies each year. For assessment purposes, it has been assumed that the 100 tons (91 tonnes) of herring allocated to each license are killed (Shields et al. 1985). This data is treated as an additional seine removal. The allocations to the SOK fishery back to its initiation in 1975 have now been tabulated and are included in the current analysis.

Age structure data are used in both assessment models. The information from catch samples is used for years when there were commercial fisheries. Pre-fishery charters began in 1975 and these samples are used in addition to samples taken from the catch, particularly in areas with no fisheries, or when catch samples are few in number or not representative of the entire catch. Additional data used in both models are annual estimates of the mean weight-at-age. During the 2001/02 season a total of 392 herring samples (79 roe, 20 food, 257 test fishery and 36 miscellaneous others) were collected and processed compared to 261 in the previous year. Of the roe and test fishery samples, 28 were taken in the Queen Charlotte Islands assessment area (another 13 from Area 2W), 69 in the Prince Rupert area, 74 in the Central Coast, 79 in the Strait of Georgia, 63 on the west coast of Vancouver Island, and another 13 samples were obtained from SOK operations. The current level of sampling coverage is adequate to estimate age composition and mean weight at age for assessment analysis.

In the current assessment we continue to use the year of life convention for ageing adopted in the 1991 assessment. Fish which were previously named age 3 are now referred to as the 2^{+} age class. In a few instances the text refers to age class 2^{++} which indicates all fish that are age 2^{+} and older.

2. SPAWN INDEX

2.1 INTRODUCTION

The spawn index estimation was referred to as the escapement model in previous assessments. It provides the auxiliary information for tuning the age-structured model. It was first developed for the 1984 assessments (Haist et al. 1985; Schweigert and Stocker 1988), and provides an empirical estimate of the escapement from the fishery based on egg deposition information. For most stock assessment regions, recent estimates of escapement are based on a combination of surface and Scuba survey data. Scuba surveys have been used routinely since 1987 and an increasing proportion of the herring spawning beds have been surveyed using this technique. Scuba surveys have been found to be superior to surface surveys for spawn assessment because they provide more accurate estimates of both spawn bed width and the intensity of egg deposition. A summary of the recent spawn survey coverage for the British Columbia coast is presented below. As a result of reductions in DFO resources and the consequent contracting of diving surveys to industry, there was again virtually no DFO effort directed to surface surveys in 2002, particularly outside of the assessment regions. No organized surface surveys were conducted in any of the major assessment regions. However, all areas did receive good Scuba survey coverage. Limited surface surveys were conducted in Johnstone Strait using HCRS funded contractors. Coastwide, there was a slight decrease in the total length of spawn surveyed by Scuba and surface surveys relative to 2001. The difference is attributable to decreases in spawn bed length in the Queen Charlotte Islands, Prince Rupert, and the Strait of Georgia.

Summary of the kilometres of herring spawning beds surveyed by Scuba and surface methods for major and minor stocks on the British Columbia coast in recent years, 1999-2002.

	1999			2000			2001			2002		
Assessment Region	Scuba	Surface	Total	Scuba	Surface	Total	Scuba	Surface	Total	Scuba	Surface	Total
Queen Charlotte Is.	42.1	2.4	44.5	26.6	0.0	26.6	40.2	0.0	40.2	14.8	0.0	14.8
Prince Rupert District	83.7	0.0	83.7	73.8	0.0	73.8	98.9	0.0	98.9	63.5	0.0	63.5
Central Coast	159.4	2.0	161.4	97.6	0.7	98.3	99.3	0.0	99.3	107.2	16.3	123.5
Strait of Georgia	133.8	0.0	133.8	152.5	1.3	153.8	173.5	0.0	173.5	143.7	5.3	149.0
W.C. Vancouver Is.	48.9	0.0	48.9	40.7	0.0	40.7	35.0	0.0	35.0	41.3	0.0	41.3
Other Areas	28.3	47.5	75.8	30.3	42.2	72.5	18.3	37.6	55.9	44.0	32.7	66.7
Coastwide Total	496.2	51.9	548.1	421.5	44.2	465.7	465.2	37.6	502.8	414.5	42.1	456.6

2.2 METHODS

The spawn index provides an estimate of the total egg deposition in each assessment region. The total egg deposition is an amalgamation of estimates of total number of eggs based on surface

surveys, dive surveys of the algal and bottom substrate, and surveys of the giant kelp, *Macrocystis* sp., and attached eggs. The methods adopted for deriving total egg deposition are detailed below.

Surface Surveys

Since the late 1920s, there have been organized efforts to assess the amount of herring eggs deposited throughout the British Columbia coast as an indicator of stock abundance. The parameters which have been monitored consistently are total length of each spawning bed measured parallel to the shoreline, the average width of each spawning bed, and an estimate of intensity of the spawn deposition. Prior to 1981, intensity was estimated subjectively on either a 1-5 or 1-9 scale of light to heavy (Hay and Kronlund 1987). Subsequently, intensity of egg deposition was recorded as the number of egg layers observed on each of several types of algal substrate. Beginning in 1987 an increasing proportion of the spawning beds have been surveyed using Scuba techniques as outlined below.

To provide a consistent coastwide assessment of total egg deposition throughout the time period from 1951-2002, it was necessary to intercalibrate the surface and Scuba surveys of egg deposition. Initially, the intercalibration took the form of linear equations that converted the surface survey estimates of spawning bed width and egg layers to comparable Scuba estimates (Schweigert and Stocker 1988). However, the data available for this intercalibration were limited in time and space to particular spawning beds over the course of a few years. As Scuba surveys of the spawning beds became widespread, an extensive database of estimates of the dimensions of herring spawning beds in most areas of the coast became available and a new procedure for calibrating the width of herring spawning beds estimated by surface surveys was proposed (Schweigert et al. 1993). The methodology consisted of defining spawn pools that were a grouping of herring spawning locations which were geographically adjacent and probably geomorphologically similar. Hence, diver width estimates developed for such a 'pool' were felt to be characteristic of all herring locations within that pool. For the small number of locations which could not be assigned to a pool, the median width for the herring section (Haist and Rosenfeld 1988) was used to adjust width estimates for the herring location. The median width was preferable to the mean because of the non-normal distribution of the spawn width estimates. Any pools for which fewer than 25 observations of width existed were also adjusted using the section median. For the rare instances where no median estimate was available at the section level, the median width for the assessment region was applied to calculate spawn area. The long term median spawn width for each pool, was then applied to each surface survey record to estimate a 'diver' width and combined with the estimated surface length, to determine the total area of egg deposition for each spawning bed.

To estimate egg density, it was assumed that surface and Scuba survey estimates of the number of egg layers in a spawning bed were equivalent. The database of 5111 observations of egg density per square meter from laboratory egg counts of Scuba surveyed quadrat samples was used to develop a predictive model of egg density from egg layers :

$$Eggs / m^2 = 14.698 + 212.218\ Layers$$

The relationship is statistically significant ($P<0.001$). Total egg deposition for each egg bed is then estimated from the product of total spawning bed area, and egg density predicted from the average surface egg layer estimate.

At present no methods exist for adjusting surface survey data in most areas outside the major assessment regions except in a few locations such as Johnstone Strait (Statistical Areas 9-13) where some dive surveys have been conducted. These surveys indicated that no adjustments are required for the spawn widths in Johnstone Strait because widths are very narrow and appear to be accurately assessed from the surface in this area (Schweigert and Haegele 1988a, b).

Scuba Surveys

For Scuba surveys, spawning bed lengths are determined by exploratory grabs with a spawn drag, rake or snorkelling to define the limits of the areas of egg deposition. A systematic sampling regime is employed whereby transects are set across the egg bed perpendicular to shore at 350 m intervals. Corresponding spawning bed widths are estimated as the mean of all transect lengths within the spawning bed. Estimates of mean egg density are based on a two-stage sampling design (Schweigert et al. 1985, 1990). Average egg density for each spawning bed is estimated, as the weighted mean of the means of a series of quadrats located along each transect, where the weighting is based on the length of each transect. For each quadrat, observations are made on several variables: type of algal substrate; proportion of the quadrat covered by each algal type; number of layers of eggs on each algal type; proportion of the bottom substrate covered by eggs; and an estimate of the number of egg layers on the bottom substrate. In some areas, assessments are also made of the egg deposition on the giant kelp as described in a following section.

Egg deposition for each sampling quadrat is estimated from the predictive equation described in the 1989 assessment (Haist and Schweigert 1990, Schweigert 1993). Egg density for each vegetation subfraction is estimated as follows using non-linear regression ($P<0.0001$):

$$Eggs_{ij} = 1033.6694\, L_{ij}^{0.7137}\, P_{ij}^{1.5076}\, V_{ij}\, Q_j.$$

where

$Eggs_{ij}$ = estimated number of eggs in thousands per m^2 on vegetation type i in quadrat j

L_{ij} = number of layers of eggs on algal substrate i in quadrat j,
P_{ij} = proportion of quadrat covered by algal substrate i in quadrat j,
V_{1j} = 0.9948 parameter for sea grasses in quadrat j,
V_{2j} = 1.2305 parameter for rockweed in quadrat j,
V_{3j} = 0.8378 parameter for flat kelp in quadrat j,
V_{4j} = 1.1583 parameter for other brown algae in quadrat j,
V_{5j} = 0.9824 parameter for leafy red and green algae in quadrat j,
V_{6j} = 1.0000 parameter for stringy red algae in quadrat j,
Q_1 = 0.5668 parameter for 1.00 m^2 quadrats,
Q_2 = 0.5020 parameter for 0.50 m^2 quadrats,
Q_3 = 1.0000 parameter for 0.25 m^2 quadrats.

Total egg density (thousands of eggs per m^2) for each quadrat is then estimated by summing the egg density estimates over the vegetation types,

$$Eggs_j = \sum_i eggs_{ij}.$$

Beginning in 1988 samples of algae and the attached eggs from entire quadrats were collected and processed to evaluate model predictions of egg density relative to sample egg counts. Due to funding shortfalls, no samples have been collected since 1997 and model predictions of egg numbers per sample quadrat are assumed to be unbiased for use in the assessment of egg density.

Eggs on Bottom and *Macrocystis*

Eggs on rock are estimated from the product of the proportion of the quadrat covered by eggs, number of egg layers, and 340,000 eggs/m^2 (Haegele *et al.* 1979). Eggs on rock also includes eggs on other inorganic substrata as well as egg deposition on very short (1-2 cm) red algae, calcareous encrusting algae, worm tubes, logs, etc. Total egg density for each quadrat is the sum of eggs on vegetation plus eggs on rock.

In some northerly areas such as the Queen Charlotte Islands and the Prince Rupert District, a significant proportion of the total egg deposition can occur on the giant kelp, *Macrocystis* sp., with smaller amounts in some localities on the Central Coast and west coast of Vancouver Island. The approach we have adopted for routine Scuba surveys follows that outlined by Haegele and Schweigert (1985). The Scuba transects which are used to assess egg density on understory vegetation are also used to enumerate *Macrocystis* plants and fronds within 1 m on either side of the transect line. An egg prediction equation has been developed (Haegele and Schweigert 1990) to estimate egg numbers for an individual plant:

$$Eggs/Plant = 0.073\ Layers^{0.673}\ Height^{0.932}\ Fronds^{0.703}$$

where

Eggs/Plant = total number of eggs on the *Macrocystis* plant in millions,
Layers = average number of egg layers on each *Macrocystis* plant,
Height = total height of the *Macrocystis* plant in metres,
Fronds = total number of fronds per *Macrocystis* plant.

This equation estimates the number of eggs occurring on a plant of a specific height with a certain number of fronds and egg layers. In practice, the synoptic Scuba survey estimates only the average number of egg layers per plant, the average plant height, and the average number of fronds per plant along each transect. These quantities are used in the above equation to estimate the total egg numbers per plant for each transect. These estimates are averaged across transects to obtain an average number of eggs per plant for the entire *Macrocystis* bed.

This information may then be combined with the estimate of the density of plants and the estimated area of the *Macrocystis* bed to obtain an estimate of the total number of eggs deposited on the kelp:

$$Total\ Eggs\ on\ Macrocystis = Eggs\ Plant^{-1} \bullet Plants\ m^{-2}$$

This egg deposition is then added to the estimated eggs on the understory vegetation to determine a total egg deposition for that spawn pool.

Biomass Estimates for Minor Stocks

Biological sampling data and spawn surveys for the minor stocks in Areas 2W and 27 have been intermittent, making age-structured analysis difficult. Alternatively, escapement from the fishery from egg deposition surveys, plus total catch can be used to provide an estimate of the pre-fishery spawning stock biomass for these areas. A harvest rule of 10% of the previous year biomass estimate has been in place for several years for these minor stock areas. The following relationship may be used to estimate pre-fishery biomass for each area (Schweigert 1993), if all pertinent data are available:

$$B_j = C_j + Eggs_j \bullet \left(\frac{\sum_{3}^{10} P_{ij} W_{ij}}{\sum_{3}^{10} P_{ij} F_{ij} SR_{ij}} \right)$$

where

B_j = total pre-fishery mature biomass in tonnes in year j,
C_j = total catch in tonnes in year j,
$Eggs_j$ = total egg deposition in billions in year j,
P_{ij} = proportion of fish at age i in year j in the spawning run,
F_{ij} = fecundity of females of age i in year j,
SR_{ij} = sex ratio or proportion of females at age i in year j,
W_{ij} = mean weight of fish at age i in year j in tonnes.

However, estimates of fecundity, age composition, and mean weight at age are not available each year so a simpler method is used to estimate biomass from the estimate of total egg deposition. Total egg deposition estimates for all spawning beds from all three types of survey (surface, dive, and kelp) are summed within each area and the total egg deposition is converted to tonnes of spawning fish based on an estimate of 100 eggs per gram of herring on average (Hay 1985). The total catch is obtained from sales slip information or verified plant landed weight data and added to the the escapement to determine current biomass. Estimates of mature biomass for Areas 2W and 27 based on this analysis are presented in Table 2.1.

Table 2.1. Estimates of spawning stock biomass, catch , and pre-fishery stock abundance (tonnes) for the minor stocks in areas 2W and 27 for 1971-2002.

	Area 2W*			Area 27		
Season	Spawners	Catch	Stock	Spawners	Catch	Stocks
1970/71	635	0	635	366	0	366
1971/72	998	0	998	345	0	345
1972/73	1782	706	2488	2323	0	2323
1973/74	1705	403	2109	0	526	526
1974/75	1374	449	1824	1307	0	1307
1975/76	994	68	1062	230	79	309
1976/77	1191	0	1191	647	0	647
1977/78	1898	575	2472	3386	150	3536
1978/79	540	691	1231	6455	693	7148
1979/80	2323	0	2323	12916	519	13435
1980/81	1450	861	2311	1882	671	2553
1981/82	5756	1225	6981	3670	571	4241
1982/83	5671	2518	8189	1877	254	2131
1983/84	2129	0	2129	2507	352	2860
1984/85	1169	199	1368	571	182	1640
1985/86	507	0	507	3194	96	3290
1986/87	360	0	360	706	364	1070
1987/88	2450	0	2450	1459	364	1823
1988/89	3748	0	3748	3837	364	4201
1989/90	8768	2272	11040	3439	246	5174
1990/91	2796	2558	5355	3360	246	3606
1991/92	3544	1284	4827	2621	699	3320
1992/93	75	1306	1380	5318	731	6049
1993/94	210	0	210	5020	591	5610
1994/95	0	0	0	2213	543	2756
1995/96	0	0	0	1259	364	1623
1996/97	0	0	0	1719	96	1815
1997/98	390	180	570	2006	273	2279
1998/99	0	0	0	578	96	674
1999/00	265	0	265	1119	96	1215
2000/01	31	0	31	178	96	274
2001/02	134	0	134	820	32	852

*- No estimates of stock biomass are available in area 2W for 1995-97 and 1999. Spawning activity was observed in the area but no surveys were conducted or surveys did not detect spawn.

3. AGE-STRUCTURED MODEL

3.1. INTRODUCTION

An age-structured model, based on the error structure suggested by Fournier and Archibald (1982), has been used to assess B.C. herring stocks since 1982. Ongoing revisions to the model have made it more consistent with the life history of herring and the fisheries that are analyzed. The current version uses auxiliary information in the form of spawning escapement data, separates catch and age composition data by gear type, and includes availability parameters to estimate partial recruitment to the spawning stock. Model parameters are estimated simultaneously using a maximum likelihood method. The model has used estimates of spawning stock biomass as the abundance or 'spawn index' for parameter estimation beginning in 1994 (Schweigert and Fort 1994). Recent changes to the model are described in last year's assessment report (Schweigert 2001). The model is implemented in the C^{++} programming language using AD model builder software (Otter Research Ltd, 2001).

3.2. METHODS

Data Sources

The input data for the age-structured analysis differs from previous years. Beginning in the current assessment, spawn index and catch at age estimates are derived from an Access database (funded by the Herring Conservation and Research Society (HCRS)) that has been developed over the past 3 years. The process for amalgamating data in space and time differs from that in previous assessments but overall spawn index estimates and numbers of fish caught do not differ markedly from the earlier assessments (Appendix 1). The Access database summarizes spawn deposition data on a transect by transect basis tabulating totals by spawning bed which are summed by herring section and then assessment region for further analysis rather than an ad hoc approach used previously whereby geographically adjacent transects were analysed together based on the analyst's best judgement. The total estimated catch tonnages are converted to pieces by section and fishery period (May-Sept., Oct.-Dec., Jan.-April) and totalled by year. The age composition and mean weight data from other similar fishery period/gear combinations in the same season or adjacent sections are applied to the catch when biological data are not available. Previously, if biological data were unavailable for a fishery period/gear combination the catch was added to other fishery catches with similar gear in the same season. A summary of the age composition data for each assessment region is presented in Figure 4.0.

The Population Model

Purse seines and gillnets are the two types of fishing gear commonly used in B.C. herring fisheries. Seine nets are assumed to be non-selective for herring while gillnets are selective for larger, older fish. Herring fisheries have concentrated primarily on fish which are on, or migrating to the spawning grounds. Therefore, the relative availability of age classes to non-selective gear should be equivalent to the partial recruitment of age classes to the spawning stock. The age-structured model explicitly separates availability (partial recruitment) and gear selectivity. Seine and gillnet fisheries are usually temporally separate so catch and age-composition are partitioned into fishing periods, separating data for the different gears. Three fishing periods are modelled as follows. In this and previous assessments, the first period encompassed all catch prior to the spring roe herring fisheries. This included

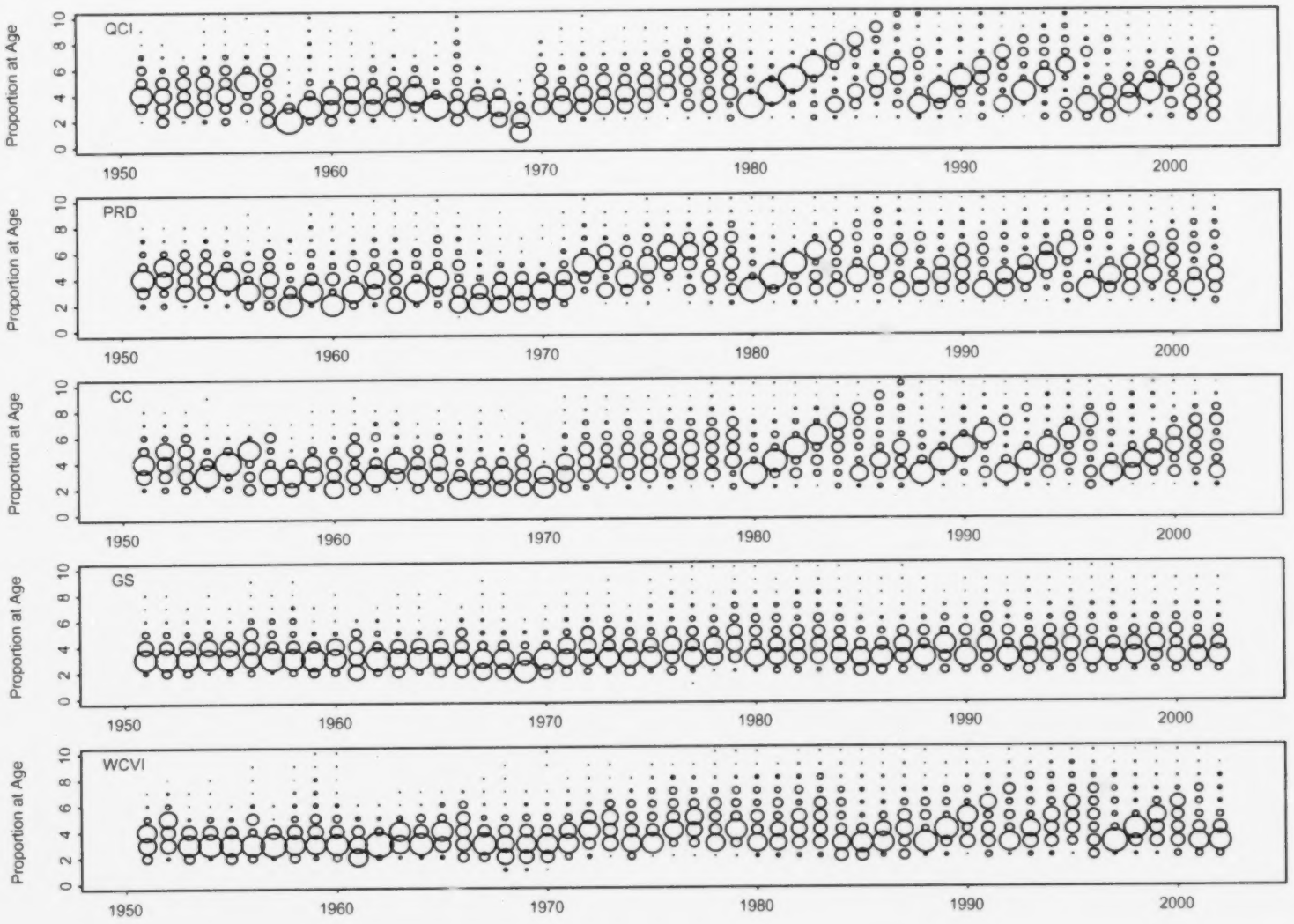

Figure 3.0. Age composition estimates for five major assessment regions from 1951-2002.

reduction fishery catches prior to 1968 and the winter food and bait fisheries since 1970. Most of this catch was taken by seine gear although small amounts were caught with trawl nets (which are also assumed to be non-size selective). The second fishing period includes all seine roe herring catch and the third period includes all gillnet roe herring catch. For the current assessment, the Access database summarizes catch-at-age data by periods (May-Sept., Oct.-Dec., Jan.-April) that differ slightly from the earlier approach. However, the catch-at-age is still tabulated into reduction and roe fishery periods as was done previously for further analysis.

In the population model for each assessment region, let T_{ij} be the total number of fish in age class j at the beginning of season i, where season is equivalent to year, and λ_{ij} be the proportion of age j fish which are available to the fishery. Then N_{ij1}, the total number of age class j fish which are available at the start of period 1 in season i is given by

$$N_{ij1} = \lambda_{ij} T_{ij}, \text{ where } 0 \langle \lambda_{ij} \langle 1 \qquad 3.1$$

To model the fishing process, a form of the catch equations which models fishing and natural mortality as continuous processes over time period r, is used:

$$C_{ijr} = \frac{F_{ijr}}{F_{ijr} + M_r}\left(1 - \exp\left(-F_{ijr} - M_r\right)\right) N_{ijr},$$

and, for $r < p$

$$N_{ijr+1} = N_{ijr} \exp\left(-F_{ijr} - M_r\right),$$

where

C_{ijr}	is the catch of age class j in season i for period r,
F_{ijr}	is the fishing mortality of age class j in season i for period r,
M_r	is the natural mortality for period r,
N_{ijr}	is the number of fish in age class j in season i for period r,
i	is the number of seasons (n=52),
j	is the number of fishing periods (p=3),
k	is the number of age classes (k=9).

$N_{i+1,j+1,1}$ is defined by equation 3.1 where for $j+1 < k$

$$T_{i+1,j+1} = N_{ijp} \exp\left(-F_{ijp} - M_p\right) + T_{ij}\left(1 - \lambda_{ij}\right) \exp \sum_r - M_r \qquad 3.2$$

In the model the last age class, k, accumulates all fish aged k and older, so for $j+1=k$ equation 3.2 is replaced by

$$T_{i+1,k} = N_{i,k-1,p}\exp\left(-F_{i,k-1,p} - M_p\right) + T_{i,k-1}\left(1-\lambda_{i,k-1}\right)\exp\left(\sum_r -M_r\right)$$

$$+ N_{ikp}\exp\left(-F_{ikp} - M_p\right) + T_{ik}\left(1-\lambda_{ik}\right)\exp\left(\sum_r -M_r\right).$$

To reduce the number of parameters to be estimated, assumptions are made about the form of the availabilities and mortalities. The availabilities are formulated to increase with age and are set to 1 for age 6+ and older. For age 3+ to 5+ the availabilities are constant between years, that is,

$$\lambda_{ij} = \lambda^{\bullet}_{j},$$

The proportion of age 2^+ fish which are mature appears to vary among years (Haist and Stocker 1985) and some reduction fisheries targeted on immature 1^+ fish. Therefore, the availability for these two age classes is estimated for each year for which there is age-composition data, with the exception of the final year. In the final year, the availability for age 1+ and 2+ fish is set equal to the average over all years in the time series.

For the selective gillnet fishery (i.e. fishing period 3), fishing mortality is separated into age selectivity and fishing intensity components. Following Doubleday (1976),

$$\ln\left(F_{ij3}\right) = \alpha_{i3} + b_j \qquad 3.2a$$

where α_{i3} represents the general level of fishing mortality due to the gillnet fishery in season i, and b_j represents the relative selectivity of the gear for age-class j. The b_j are parameterized such that age selectivity is modelled as a function of annual average weights-at-age. A modified logistic equation is used,

$$b_{ij} = \frac{1}{1+\exp(\rho - \tau\, g_{ij}^{\omega})}$$

where g_{ij} is $\log_e$ of the geometric mean weight-at-age j in year i. The b_{ij} replace the b_j in equation 3.2a.

For non-selective fisheries (i.e. fishing periods 1 and 2) only fishing intensity parameters are estimated, that is

$$\ln\left(F_{ijr}\right) = a_{ir}.$$

As in last year's assessments, an average natural mortality parameter, $M_{\bullet}$, is estimated. It is assumed that most of the natural mortality occurs following spawning and over the course of the summer and early winter prior to the first fishery (period 1). Little or no natural mortality is assumed during the course of the roe fisheries (periods 2 and 3) which occur over a roughly 2 week period at the end of the year. Hence, various proportions of the annual natural mortality for the three fishing periods is modelled as,

$M_1 = 0.95M_\bullet$
$M_2 = M_3 = 0.025M_\bullet$

Additional structure is built into the model through the inclusion of annual spawn data (spawn index, I_i). Spawning occurs at the end of the season so the number of spawners at age j in season i (G_{ij}) is estimated by

$$G_{ij} = N_{ijp} \exp\left(-F_{ijp} - M_r\right) \qquad \text{where } j>1$$

and the spawning stock biomass, which is assumed to be proportional to egg production, in season i, (R_i) is

$$R_i = \sum_j w_{ij} G_{ij},$$

where w_{ij} is the average weight-at-age j in season i. The errors in the spawn index observations (I_i) are assumed to be multiplicative so that

$$I_i = q\, R_i \exp(\xi_i), \qquad 3.3$$

where q is a spawn conversion factor and ξ_i is a normally distributed random variable with mean 0 and variance σ_1^2. For the model described above the parameters to be estimated are:

T_{i1}, for all seasons i,
T_{ij}, for age classes 1+ to k,
$\lambda^\bullet_j$, for age classes 3+ to 5+,
λ_{ij}, for age classes 1+ and 2+, for seasons 1 to n-1,
α_{ir}, for all fisheries i,r,
ρ, τ, ω, $M_\bullet$ and q.

The $\lambda^\bullet_j$ and λ_{ij} are parameterized to constrain their values between 0 and 1. The parameter σ_1^2 is not estimated in the reconstructions, but is fixed as discussed later on.

The Objective Function

Data input to the stock reconstruction are:

S_{ijr}, the number of sampled fish aged j in season i for period r,
O_{ir}, the estimated number of fish caught in period r of season i,
I_i, the estimated escapement biomass or spawn index in season i,
w_{ij}, the mean weight-at-age j in season i,
g_{ij}, the $\log_e$ of the geometric mean weight-at-age j in season i.

The error structure suggested by Fournier and Archibald (1982) for the observations S_{ijr} and O_{ir} is used:

1) the S_{ijr} are obtained from ageing random samples of fish from the catch (and there are no ageing errors, i.e. a multinominal sampling distribution).

2) the error structure for the estimated number of fish caught (O_{ir}) is log-normal. That is,

$$O_{ir} = C_{ir} \exp(\xi_i),$$

where C_{ir} is the actual number of fish caught in period r in season i ($C_{ir} = \sum_j C_{ijr}$) and the ξ_i are independent normally distributed random variables with mean 0 and variance σ_3^2.

3) the random variables S_{ijr} and O_{ir} are independent.

Given these stochastic assumptions, the log-likelihood function (ignoring the constant term), for the parameters P_{ijr} $(P_{ijr} = C_{ijr} / C_{ir}), C_{ir}$, and σ_3^2 is

$$\sum_{ijr} S_{ijr} \ln(P_{ijr}) - \sum_{ir} \frac{(\ln(O_{ir}) - \ln(C_{ir}))^2}{2\sigma_3^2} \qquad 3.5$$

The assumption of log-normal measurement error in the observed spawn-actual spawn relationship introduces the following contribution to the log-likelihood function:

$$- \sum_i \frac{(\ln(I_i) - \ln(q R_i))^2}{2\sigma_1^2} \qquad 3.6$$

The w_{ij} and g_{ij} are assumed to be estimated without error.

The objective function described above (eqn. 3.5 & 3.6) incorporates measurement error in the proportion at age data, the total catch data and the spawn index data, with the relative magnitude of the errors related through the variance terms σ_1^2, σ_3^2, and the sample sizes $\sum_r S_{ijr}$. Because there is not enough information in the data to estimate the relative error in these observations, the variance terms are not estimated but are held at fixed values. The following variances are assumed:

$\sigma_1^2 = 0.025,$
$\sigma_3^2 = 0.0025,$

These correspond to approximately a 4% coefficient of variation in estimates of the total number of fish caught and an 15% coefficient of variation in spawn index observations.

The contribution to the objective function from the lack of fit for the age composition data for a fishery in period r in season i is:

$$V_{ir} = \sum_{r} S_{ijr} \ln P_{ijr} - \sum_{r} S_{ijr} \ln\left(\frac{S_{ijr}}{\sum_{r} S_{ijr}}\right)$$

The second term in this equation is a constant. Inclusion of this term allows comparison of the contribution to the lack of fit for the age composition data for each fishery. If the predicted and observed proportion at age data were identical, the V_{ir} would be zero.

To facilitate an assessment of the lack of model fit to the age composition data the standard deviates of the observed versus predicted proportions-at-age (Z_{ijr}) are also calculated:

$$Z_{ijr} = \frac{S_{ijr} - \left(\sum_{r} S_{ijr}\right) P_{ijr}}{\sqrt{S_{ijr}\left(1 - \frac{S_{ijr}}{\sum_{r} S_{ijr}}\right)}}$$

4. STOCK TRENDS AND ABUNDANCE FORECASTS

4.1 STOCK TRENDS

Estimates of pre-fishery stock biomass over the period 1951 to 2002 from the revised age-structured model presented in last year's assessment (Schweigert 2001) are shown in Figures 4.1 and 4.2 for the five major coastal regions. The model assumes a spawn catchability parameter, q, equal to 1 for the dive survey era and fits q for the surface era prior to 1988. In previous assessments, a single spawn catchability parameter, q, was fit to the entire time series but divergence in the trends of abundance estimated from the age-structured model and the spawn index suggested a lack of model fit. Since it is assumed that dive surveys provide a complete and unbiased estimate of spawning escapement since 1988, it was reasonable to fix the spawn catchability parameter at unity for the recent data series.

The trends in stock biomass are shown for two versions of the input data, the legacy data obtained from Fortran files and the current data from the Access database. In addition, a set of stock reconstructions are presented for the time series with a single fixed q set equal to 1, over the entire time series for comparison (Figure 4.3 and 4.4). Based on a comparison of the objective function values in each assessment region, it was determined that a model that assumes two q parameters provides a better fit to the available data than that obtained using a single fitted q parameter for stock reconstruction and forecasting.

Residual and Retrospective Analysis

The model estimate of the population egg production from equation 3.3 can be compared to the observed egg deposition and residuals reviewed for lack of model fit. The results of this comparison are shown in Figures 4.5 and 4.6 for the five major stocks. Similarly, a comparison between the observed age composition and the that determined by the model is presented for the three fishing periods and the five major stocks in Figures 4.7 to 4.11.

A retrospective analysis for the herring age-structured model with the new input data series is presented for each of the major herring stocks in Figures 4.12 and 4.13. The plots show the stock trajectory determined for each of the past ten years beginning in 1993 demonstrating the impact of additional data on model performance relative to the current assessment of stock trajectory. A comparison of the abundance forecasts for 2002 from 2001 is also presented in Table 4.1 together with the assessment of current abundance.

4.2 STOCK FORECASTS

Forecasts of stock abundance for 2003 are calculated in two ways. First, The numbers of fish at age prior to the fisheries are the numbers estimated at the beginning of the 2002/03 season multiplied by survival for the first period and the estimated availability at age. Recruitment is based on the survival and availability of the age 1+ fish estimated for the previous season. This recruitment is added to the estimated returning adults to project total abundance. Likelihood profiles for the predicted total biomass are determined and presented in Fig. 4.14 and 4.15. Secondly, as in previous assessments, recruitment is also calculated for three scenarios based on estimated numbers-at-age 2^{+} for the 1951-2002 time series. Poor, average, and good recruitment levels are calculated as the mean of the lowest 33%, the

mid 33%, and the highest 33% of the estimate of historic age 2^+ abundance. These three recruitment estimates are then added to the projected adult biomass in 2003 to provide abundance forecasts. The point values and the cumulative probability plots for these estimates are presented in Figures 4.16 and 4.17. The time series of recruitment estimates for each assessment region are presented in Figures 4.18 and 4.19.

4.3. HARVESTABLE SURPLUS

Management Considerations

The Pacific Scientific Advice Review Committee (PSARC) has reviewed the biological basis for target exploitation rate, considering both the priority of assuring conservation of the resource and allowing sustainable harvesting opportunities (Schweigert and Ware 1995). The review concluded that 20% is an appropriate exploitation rate for those stocks that are well above Cutoff or minimum spawning biomass threshold levels (PSARC 1995). The 20% harvest rate is based on an analysis of stock dynamics which indicates this level will stabilize both catch and spawning biomass while foregoing minimum yield over the long term (Hall et al. 1988, Zheng et al. 1993). A fixed escapement policy would theoretically produce higher yields and spawning stock stability but is not attainable at the operational level. For those stocks which are marginally above Cutoff the following reduced catch level is recommended:

Catch = Forecast Run - Cutoff.

This will provide for smaller fisheries in areas where the 20% harvest rate would bring the escapement down to levels below the Cutoff.

Cutoff levels have been established through a stock-recruitment curve or bootstrapping of the observed recruitment time series. Changes in model structure have historically resulted in a parallel change in Cutoff level. To minimize confusion, in 1995 the Subcommittee recommended that a fixed Cutoff level should be established for each stock based on the long-term production characteristics in relation to current environmental conditions and that this Cutoff level need not be re-evaluated on an ongoing basis. The Cutoff levels for the five major stocks are:

	1992/93 Cutoff[a]	1994/95 Cutoff	1996/97 Cutoff	**2002/03 Cutoff[c]**
Queen Charlotte Islands	11700	10700	10700	**10700**
Prince Rupert District[b]	12100	12100	12100	**12100**
Central Coast	10600	18800	17600	**17600**
Strait of Georgia	22100	21200	21200	**21200**
W.C. Vancouver Island	20300	18800	18800	**18800**

[a] - Cutoff level based on simulation model with stock-recruitment relationship, and two assessment areas on the WCVI.

[b] - Because of the poor performance of the age-structured model in this region in the past the Cutoff has not been recalculated using the bootstrap approach but is based on a stock-recruitment relationship.

[c] – A Cutoff of 14,000 tonnes was proposed for the Central Coast in 1998. Uncertainty about ASM performance in 1998 resulted in retention of the existing Cutoff.

The history of catch forecasts, recommended quotas, and actual harvests since the introduction of the Cutoff in 1985 is presented in Table 4.2.

Table 4.1. The abundance forecast from 2001 of 2002 run size showing the observed abundance and recruitment from the assessment model.

Management Region	2001 Forecast of 2002 Biomass	2002 Observed Biomass	2002 Validated Roe Catch*	2002 Escapement
Queen Charlotte Islands	13,990 (average)	7,500 (poor)	700	6,800
Prince Rupert	34,130 (average)	33,200 (average)	4,500	28,700
Central Coast	25,380 (average)	25,100 (average)	3,300	21,800
Strait of Georgia	103,100 (average-good)	135,500 (good)	17,300	118,200
West Coast Vancouver Island	22,440 (poor)	31,800 (average)	800	31,000
Total Coast	165,900	233,100	26,600	206,500

*includes test fish catch

Table 4.2. Stock biomass forecast, recommended yield, actual roe fishery quota, and roe catches (tonnes x 1000) since 1985.

		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[d]	2000[d]	2001[d]	2002[d]
QCI[f]	Forecast[a]			15.3	12.1	13.7	35.3	23.2	18.1	17.7	12.4	7.7	6.7	11.0	19.8	28.2	15.1	8.7	14.0
	Rec. Yield[b]			2.2	0.0	2.7	7.1	4.6	3.6	3.5	1.0	0.0	0.0	0.3	4.0	5.6	3.0	0.0	2.8
	Roe Quota	5.0	3.8	1.4	0.0	0.9	5.5	4.7	3.3	3.0	0.0	0.0	0.0	0.0	1.6	3.0	1.4	0.0	0.4
	Roe Catch[c]	6.3	3.6	2.0	0.3	1.4	9.0	7.0	3.8	4.0	0.3	0.0	0.0	0.0	1.4	3.0	1.8	0.0	0.7
PRD	Forecast[a]			32.1	43.8	42.6	23.3	19.4	30.5	55.1	34.1	21.9	21.2	36.1	34.0	24.4	37.0	23.2	34.1
	Rec. Yield[b]			6.4	8.7	8.5	4.7	3.9	6.1	11	6.8	4.4	4.2	7.2	6.8	4.9	7.4	4.6	6.8
	Roe Quota	5.0	6.4	5.4	7.5	7.3	3.5	2.6	4.2	5.4	4.9	2.3	2.4	5.5	5.5	2.0	4.1	2.5	4.2
	Roe Catch[c]	6.5	8.3	6.1	7.9	8.5	4.9	3.5	5.0	6.3	4.7	2.1	3.1	5.5	3.2	2.1	4.3	2.9	4.5
CC	Forecast[a]			23.0	23.8	48.5	43.2	38.2	37.7	70.1	69.8	54.4	25.8	20.7	44.5	43.4	47.0	36.8	25.4
	Rec. Yield[b]			4.6	4.8	9.7	8.6	7.6	7.5	14.0	14.0	10.9	5.2	3.1	8.9	8.7	9.4	7.4	5.1
	Roe Quota	4.1	2.3	3.3	3.7	7.8	7.4	6.2	5.3	7.8	10.3	8.5	3.2	1.4	7.8	6.9	6.3	5.2	2.8
	Roe Catch[c]	5.2	3.3	3.6	4.5	9.5	8.4	8.9	8.3	10.5	11.9	9.6	4.3	3.6	8.6	7.5	7.4	6.1	3.3
SG	Forecast[a]			53.0	46.7	49.4	55.2	69.8	59.2	91.8	97.4	69.5	63.4	77.2	72.7	78.9	84.7	82.6	103.1
	Rec. Yield[b]			10.6	9.3	9.9	11.0	14.0	11.8	18.3	19.5	13.9	12.7	15.5	14.5	15.8	16.9	16.5	20.6
	Roe Quota	4.7	0.0	8.0	6.4	7.4	7.1	9.1	9.7	11.0	14.4	11.9	10.8	13.2	13.0	11.5	13.2	13.9	16.2
	Roe Catch[c]	6.2	0.2	9.1	7.5	7.4	7.9	10.6	12.5	13.1	16.7	12.5	13.6	15.4	12.7	11.8	14.0	15.0	17.3
WCVI[g]	Forecast[a]			48.3	39.6	52.6	35.9	33.9	29.1	NA[h]	36.3	20.8	21.4	24.1	40.1	39.6	21.5	14.6	22.4
	Rec. Yield[b]			9.7	7.9	10.5	7.2	6.8	5.8	3.4[h]	7.3	2.0	2.0	4.8	8.0	7.9	2.7	0.0	3.6
	Roe Quota		0.0	9.4	8.1	10.3	7.2	6.7	2.9	2.7	5.0	1.3	0.9	3.7	7.5	5.1	1.1	0.0	0.4
	Roe Catch[c]	0.2	0.2	15.9	9.7	13.4	9.9	8.6	3.7	5.6	6.0	2.0	0.8	6.7	7.0	4.4	1.6	0.0	0.8
Coast	Forecast	0.0	0.0	171.7	166.0	206.8	192.9	184.5	174.6	234.7	250.0	174.3	138.5	169.1	211.1	214.5	205.3	165.9	199.0
	Rec. Yield	0.0	0.0	33.5	30.7	41.3	38.6	36.9	34.8	50.2	48.6	31.2	24.1	30.9	42.2	42.9	39.4	28.5	38.9
	Roe Quota	18.8	12.5	27.5	25.7	33.7	30.7	29.3	25.4	29.9	34.6	24.0	17.3	23.8	35.4	28.5	26.1	21.6	24.0
	Roe Catch	24.4	15.6	36.7	29.9	40.2	40.1	38.6	33.3	39.5	39.6	26.1	21.8	31.1	32.9	28.8	29.1	24.0	26.6

[a] PSARC stock forecast used to derive recommended yield;

[b] PSARC recommended yield, includes allocations to non-roe fisheries;

[c] Roe catch includes all test fishery catches;

[d] Catch in 1999 through 2002 were the dockside validated catch;

[e] In 1983, the quota for North of Cape Caution was 11.8 tonnes;

[f] In 1983, 1985, 1990, 1991, 1992 and 1993 catch for QCI included both areas 2E and 2W;

[g] Includes Area 27 catch in 1983 & 1984 but excludes it in 1992, 1993, 1994, 1995 following removal from assessment region;

[h] No consensus on stock status, recommended that catch not exceed 1992 level.

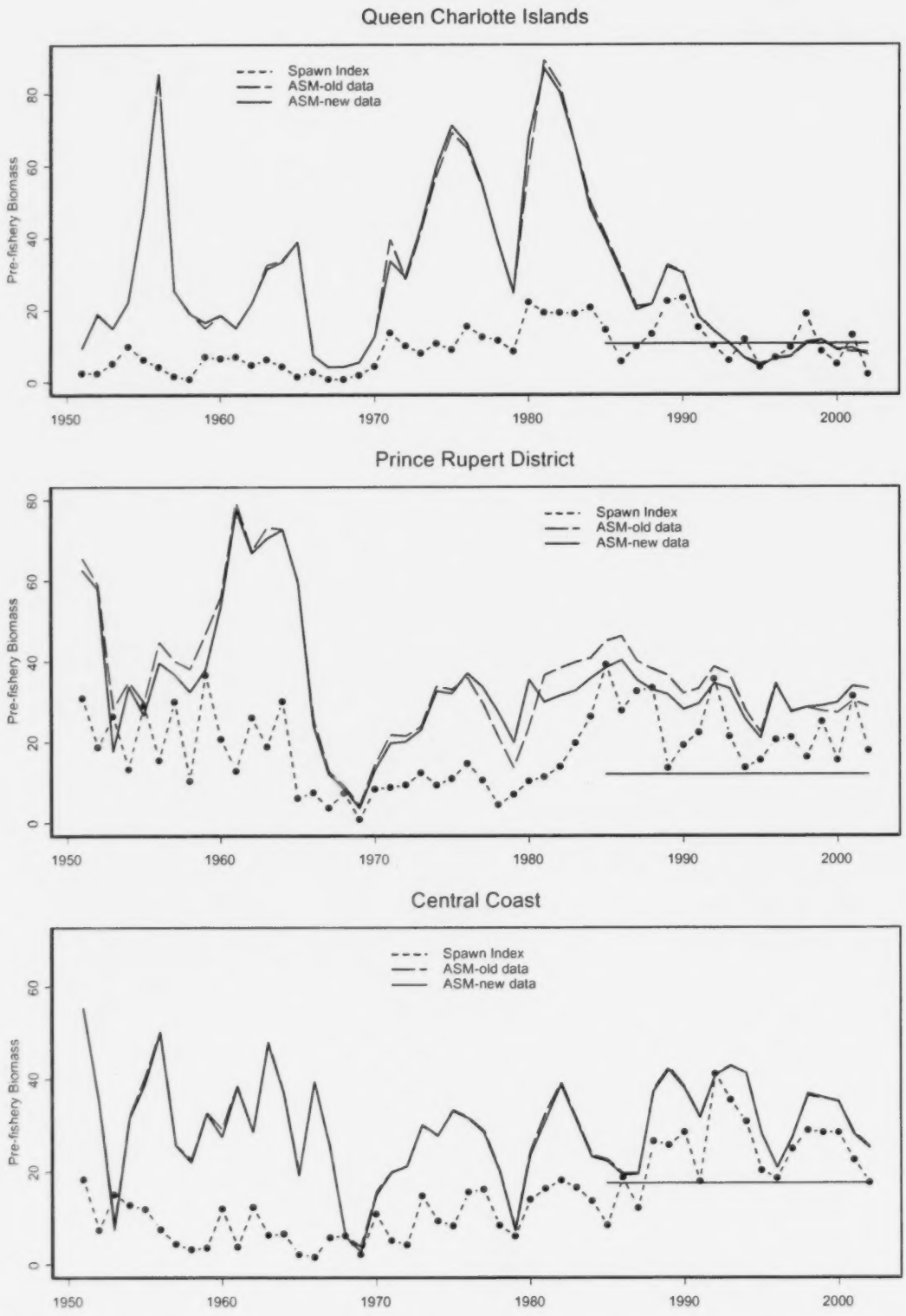

Figure 4.1. Estimates of pre-fishery spawning stock biomass (tonnes x 1000) from age-structured model (ASM) analyses for northern B.C. herring stock assessment regions, 1951-2002, for historical and new data series. Horizontal line indicates the Cutoff level.

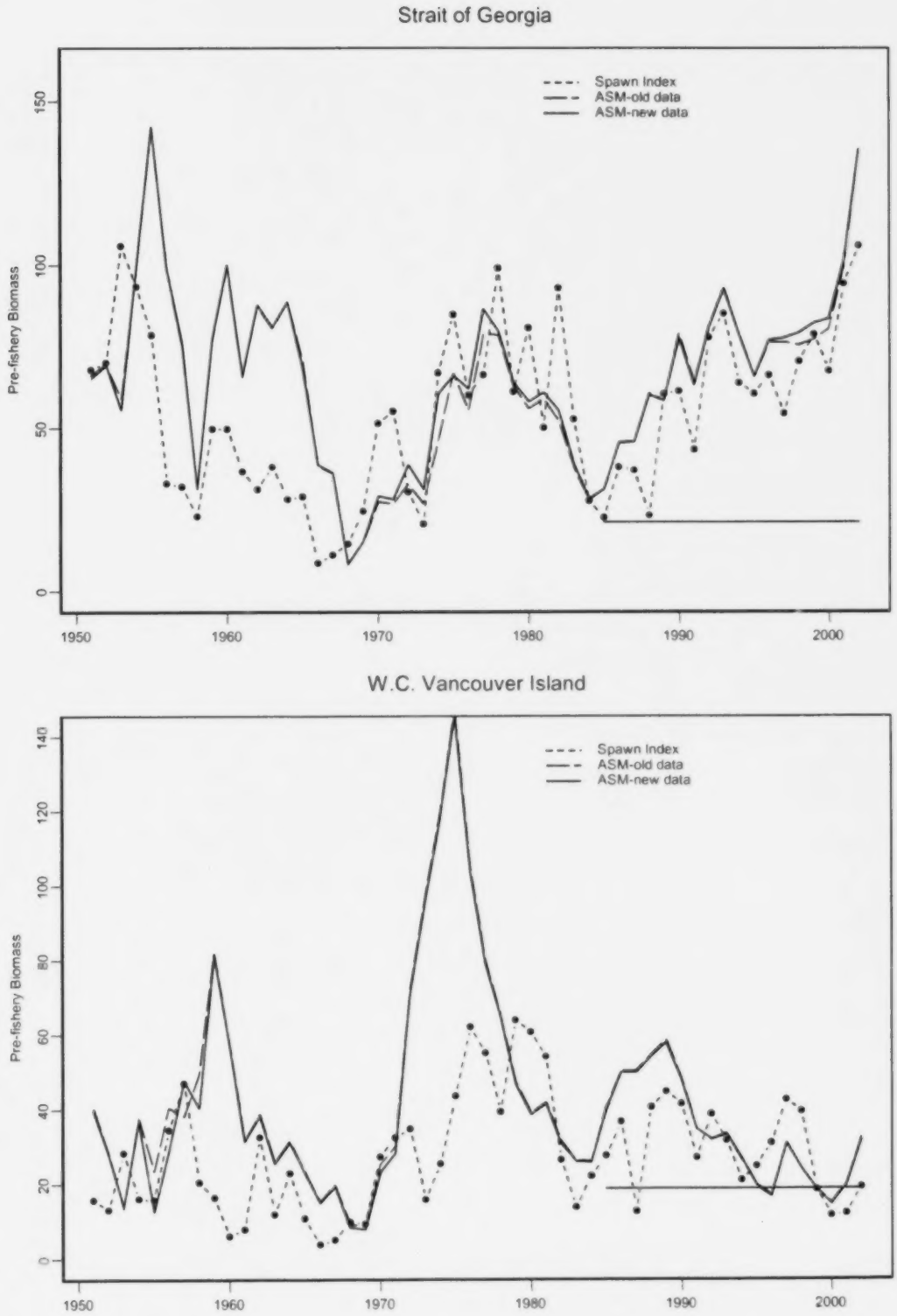

Figure 4.2. Estimates of pre-fishery spawning stock biomass (tonnes x 1000) from age-structured model (ASM) analyses for southern B.C. herring stock assessment regions, 1951-2002, for historical and new data series. Horizontal line indicates the Cutoff level.

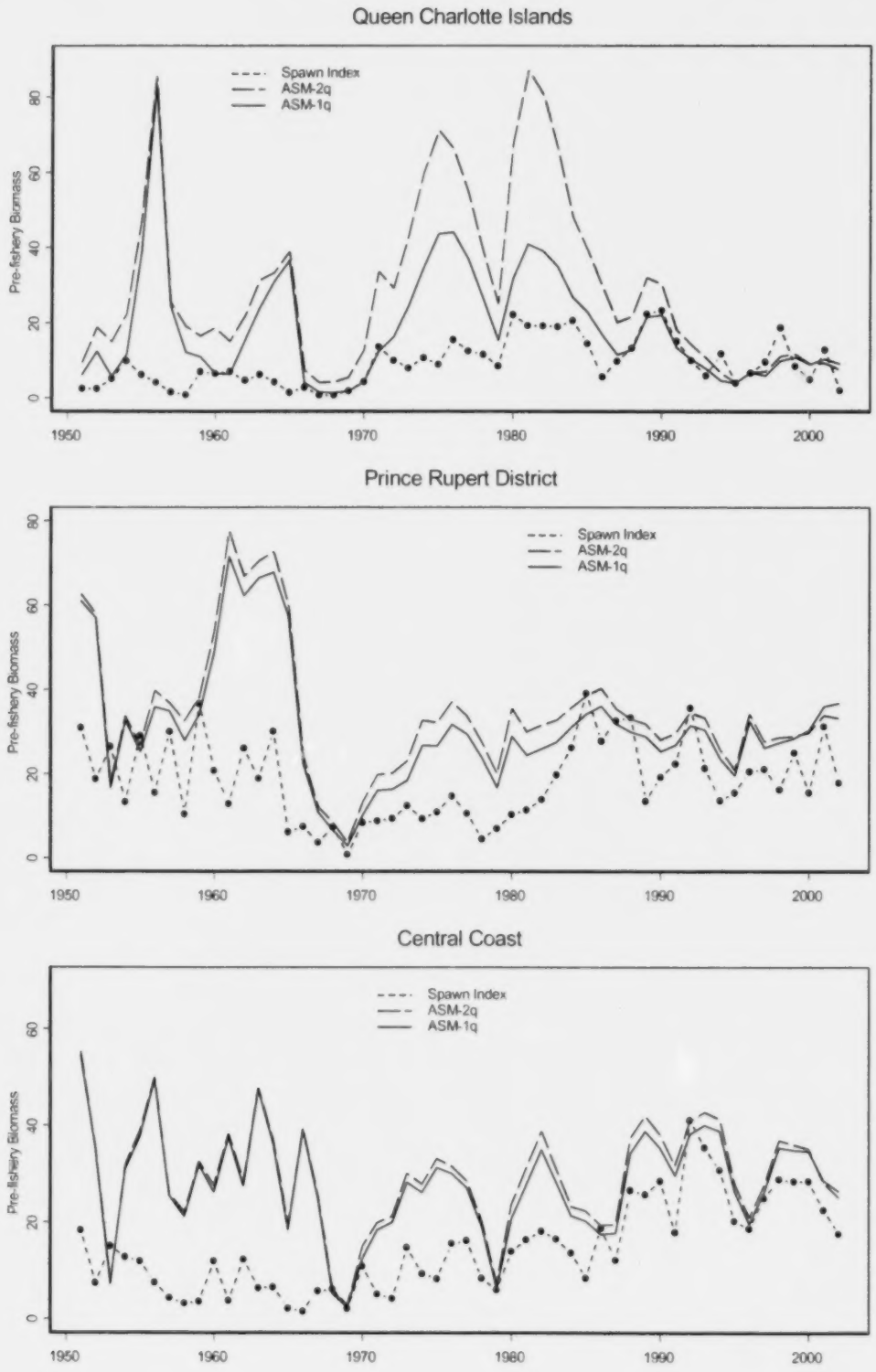

Figure 4.3. Estimates of pre-fishery spawning stock biomass (tonnes x 1000) from age-structured model (ASM) analyses for northern B.C. herring stock assessment regions, 1951-2002, assuming a single fixed q or separate q parameters for surface and dive spawn eras.

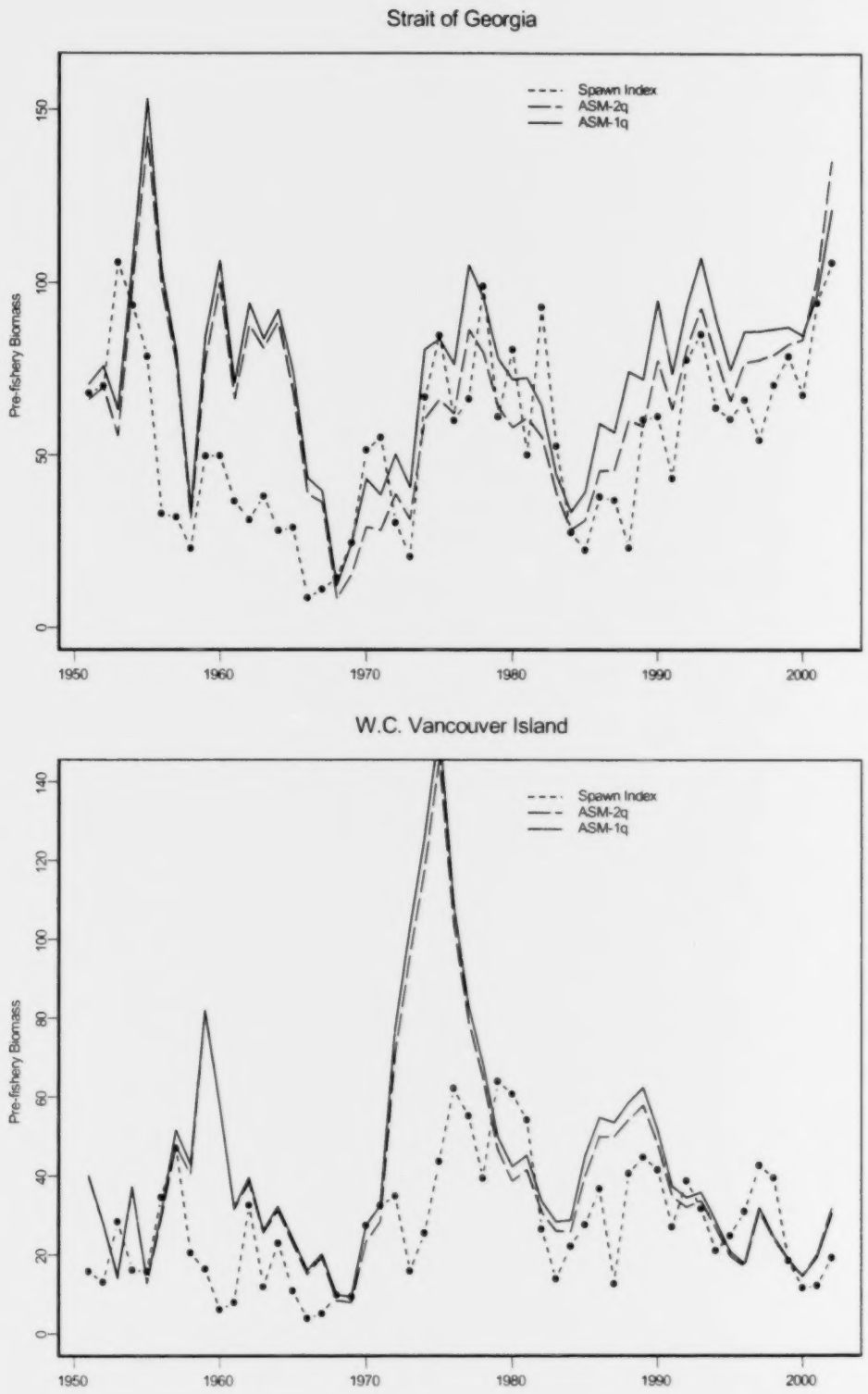

Figure 4.4 Estimates of pre-fishery spawning stock biomass (tonnes x 1000) from age-structured model (ASM) analyses for southern B.C. herring stock assessment regions, 1951-2002, assuming a single fixed q or separate q parameters for surface and dive spawn eras.

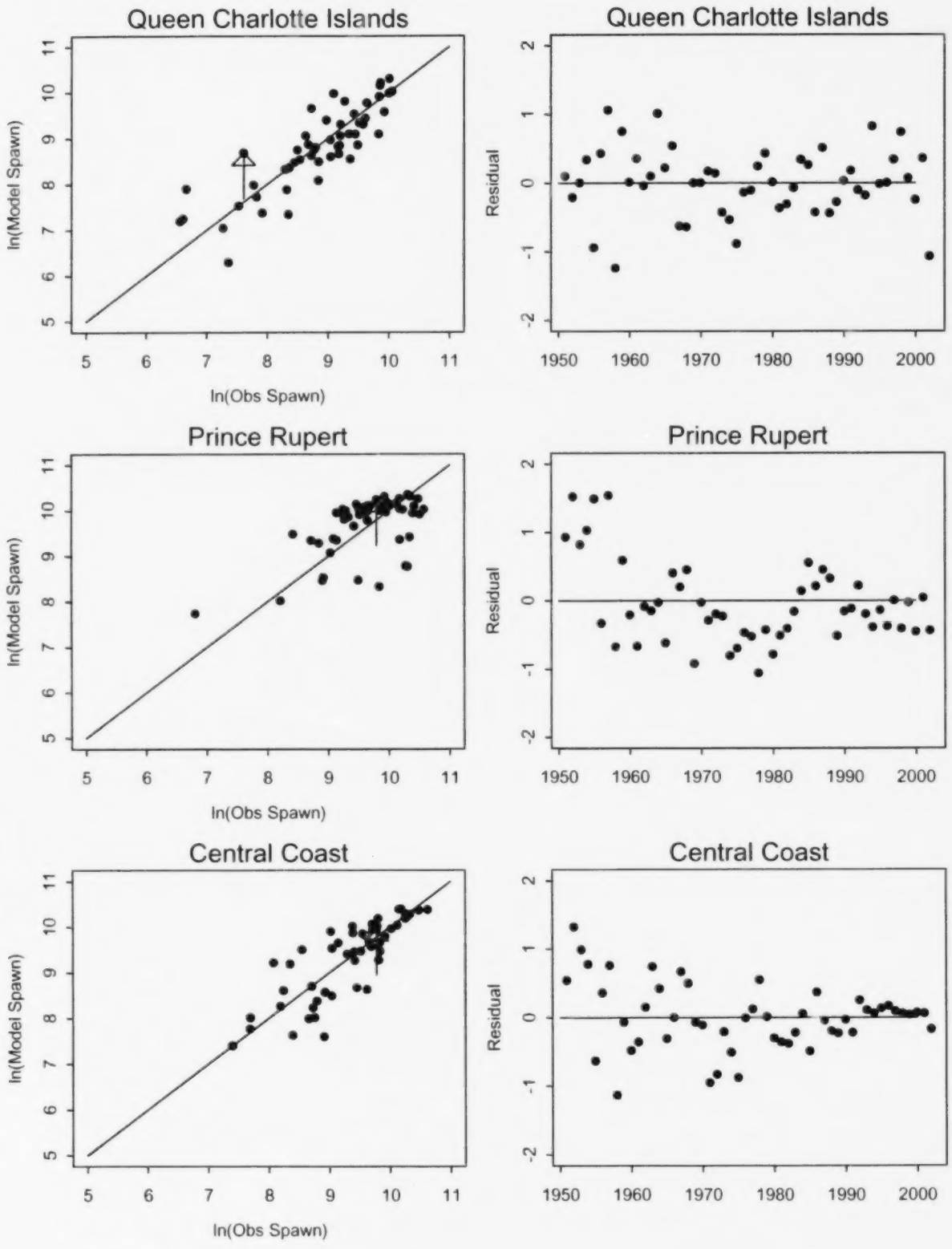

Figure 4.5. The residuals from the observed spawn - true spawn relationship for the northern assessment regions. The arrow indicates the most recent data point.

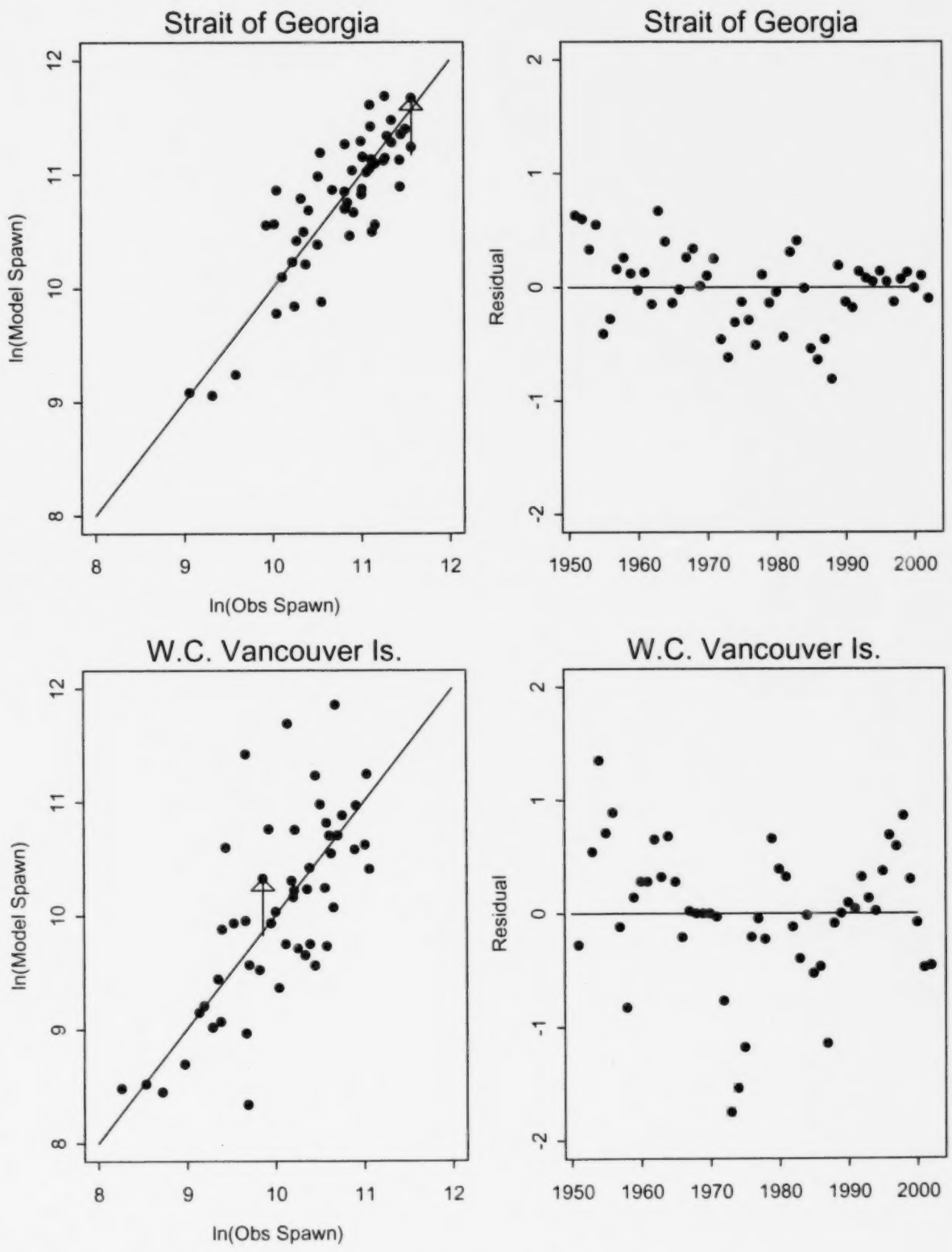

Figure 4.6. The residuals from the observed spawn - true spawn relationship for the southern assessment regions. The arrow indicates the most recent data point.

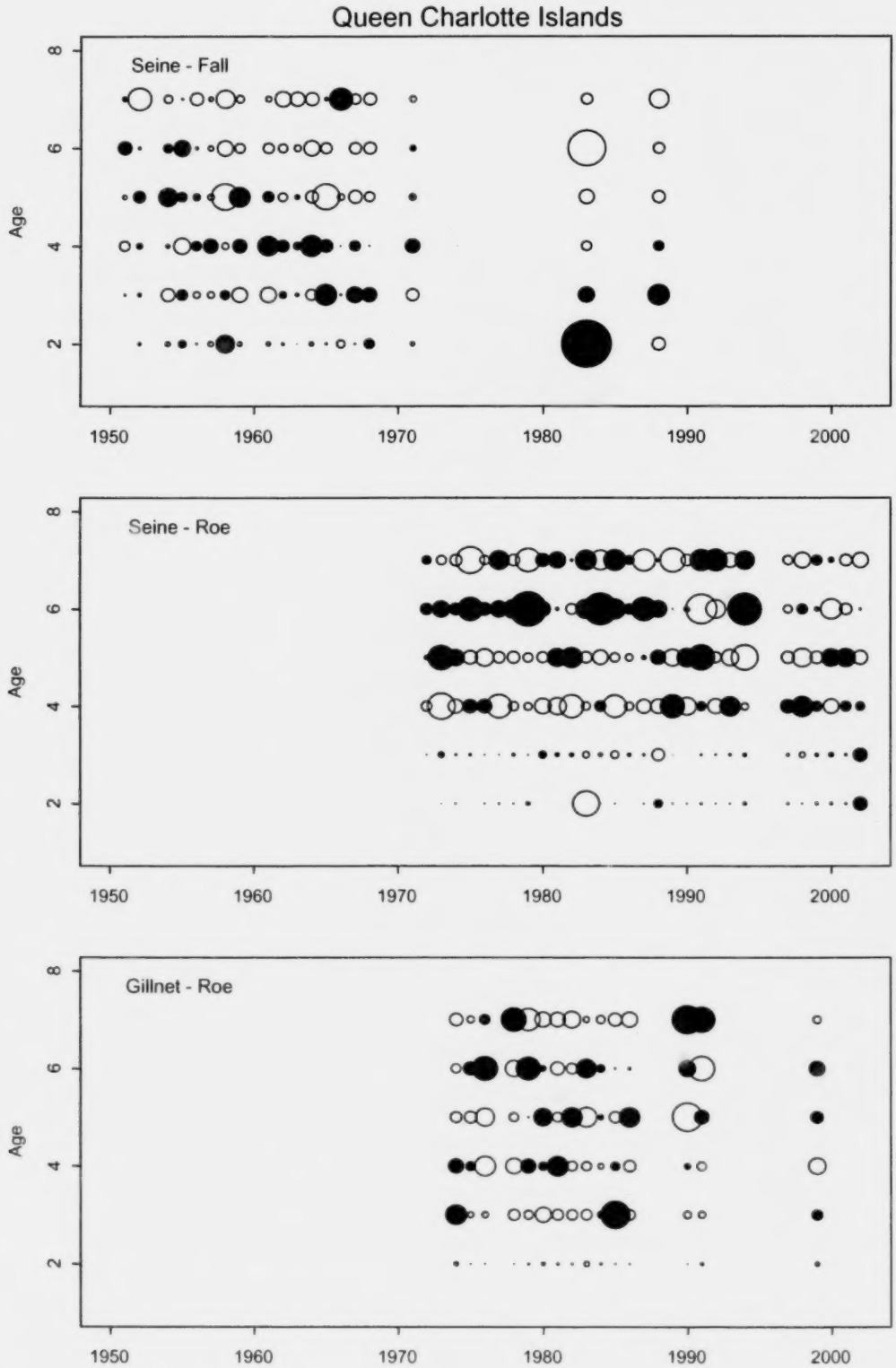

Figure 4.7. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Queen Charlotte Islands. Filled circles indicate positive residuals and open circles are negative residuals.

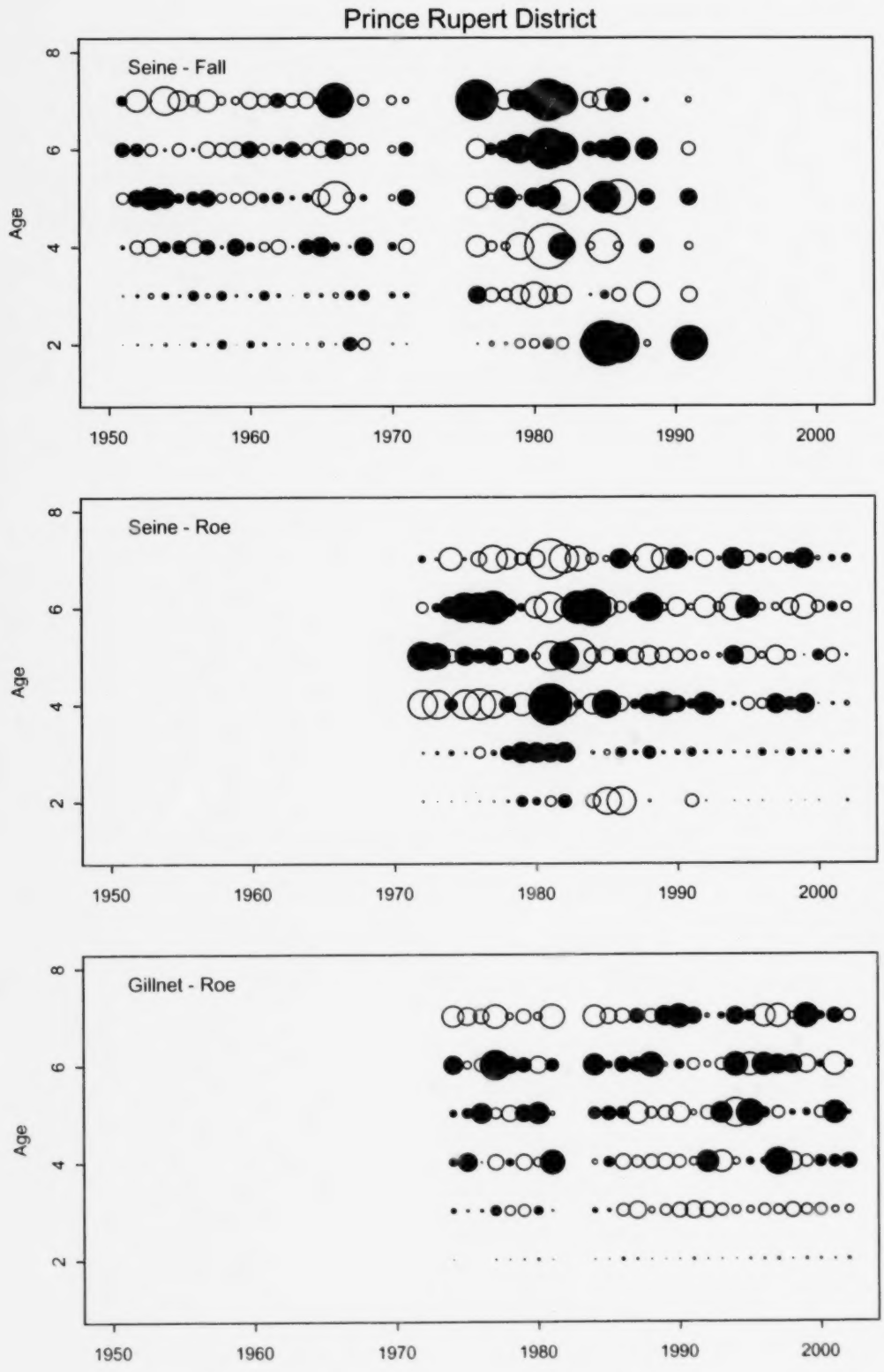

Figure 4.8. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Prince Rupert District. Filled circles indicate positive residuals and open circles are negative residuals.

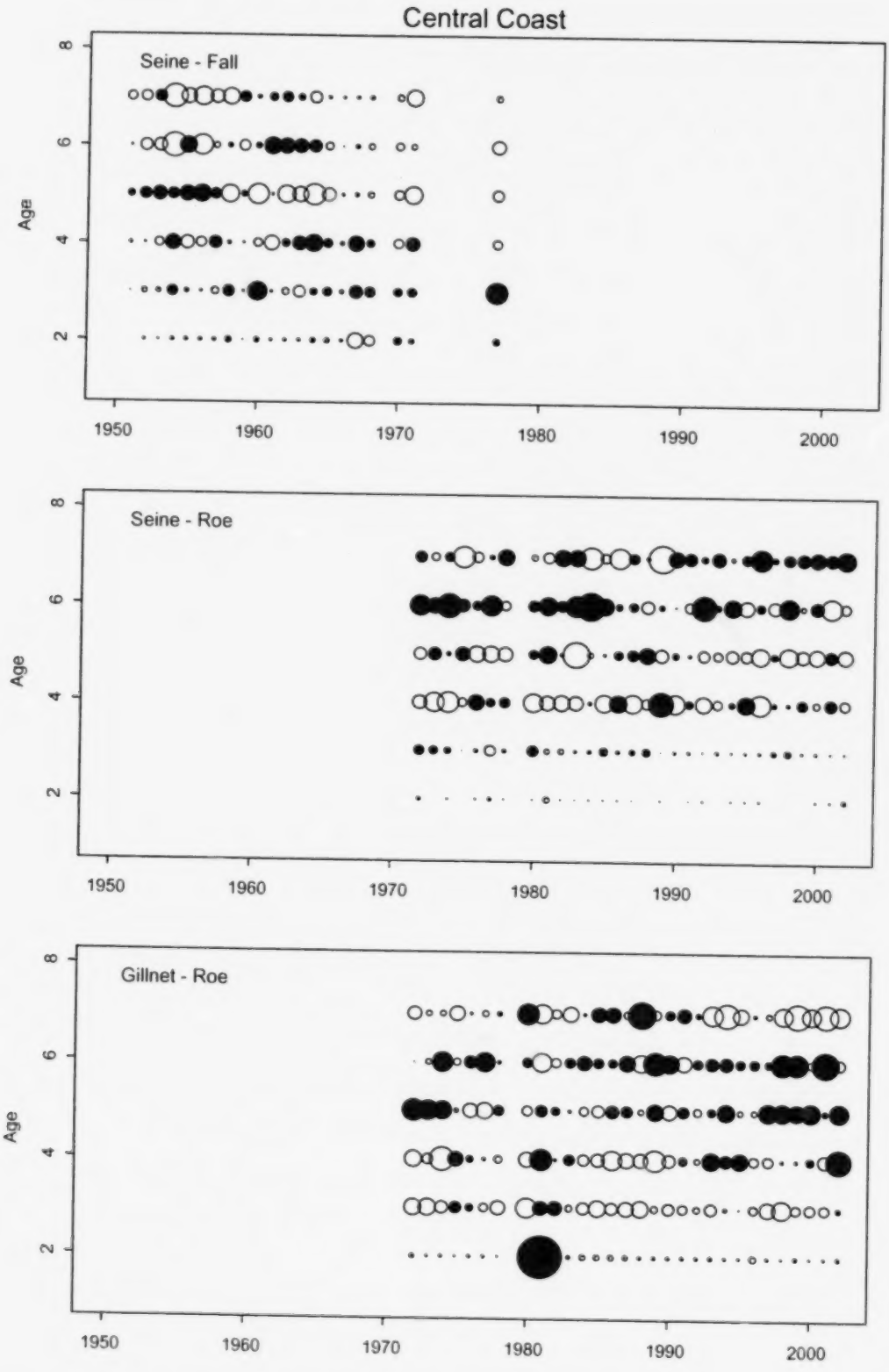

Figure 4.9. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Central Coast. Filled circles indicate positive residuals and open circles are negative residuals.

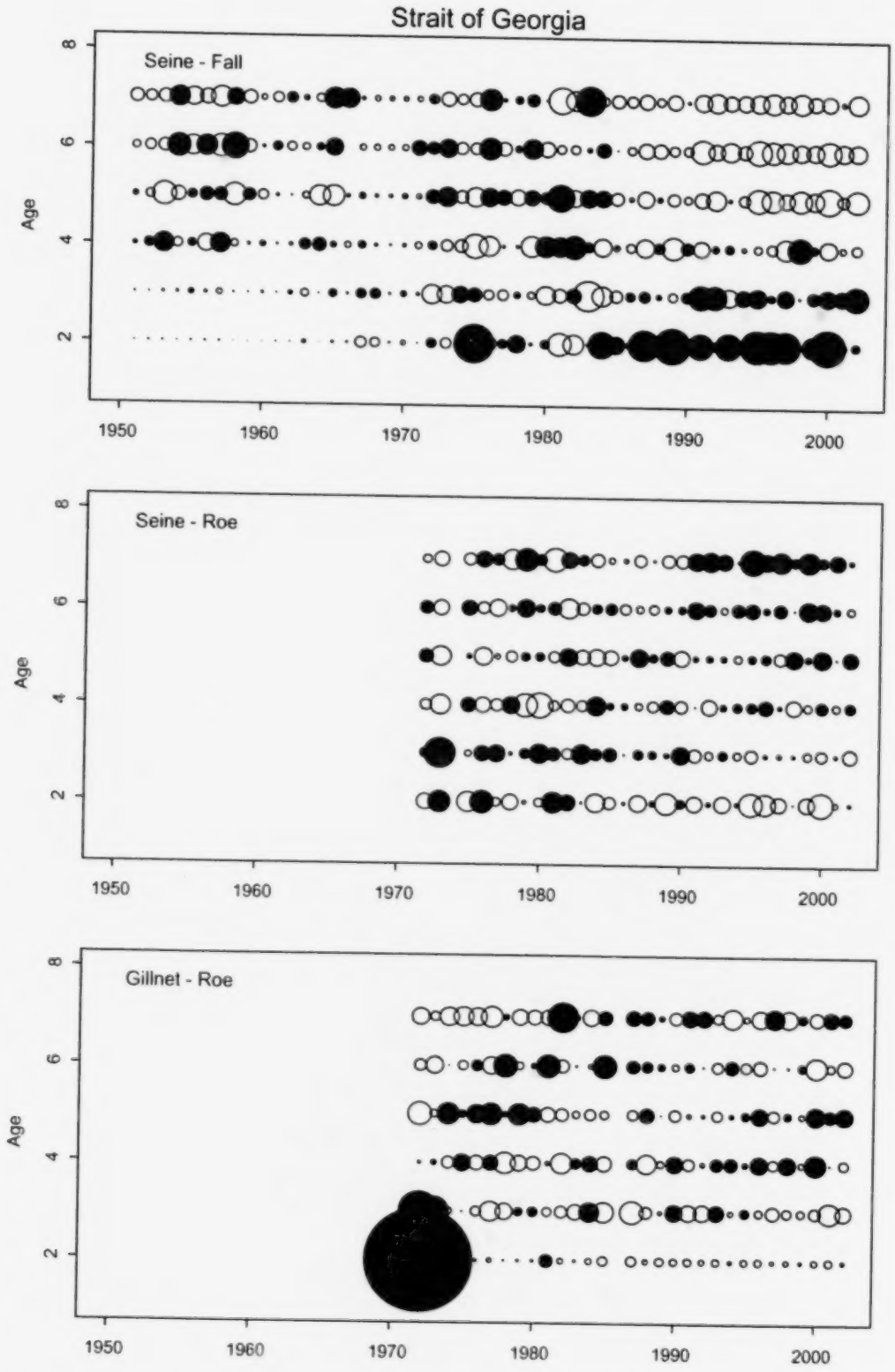

Figure 4.10. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the Strait of Georgia. Filled circles indicate positive residuals and open circles are negative residuals.

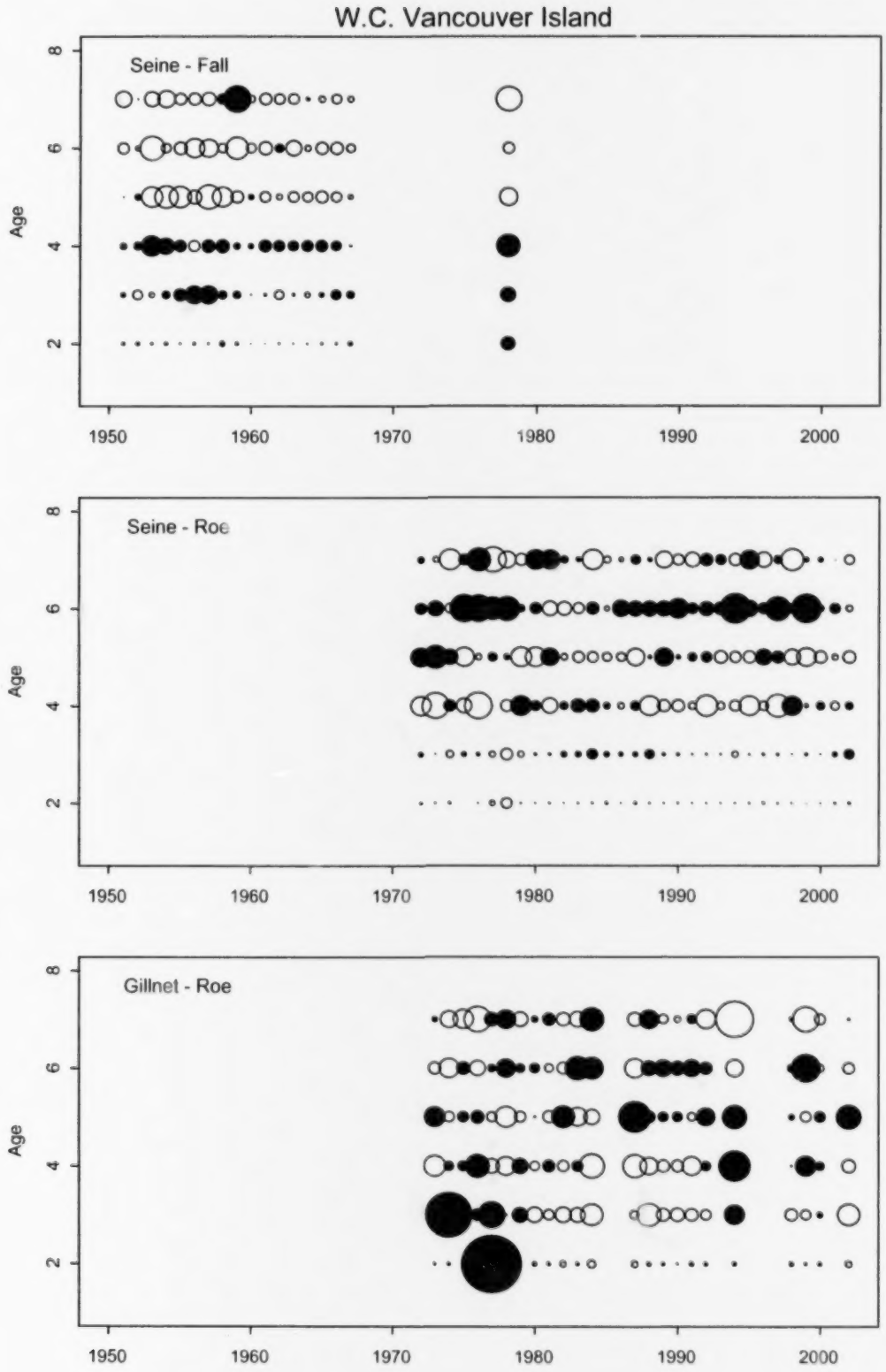

Figure 4.11. Residuals from the age-structured model fit to the catch-at-age data by year and fishing period for the west coast of Vancouver Island. Filled circles indicate positive residuals and open circles are negative residuals.

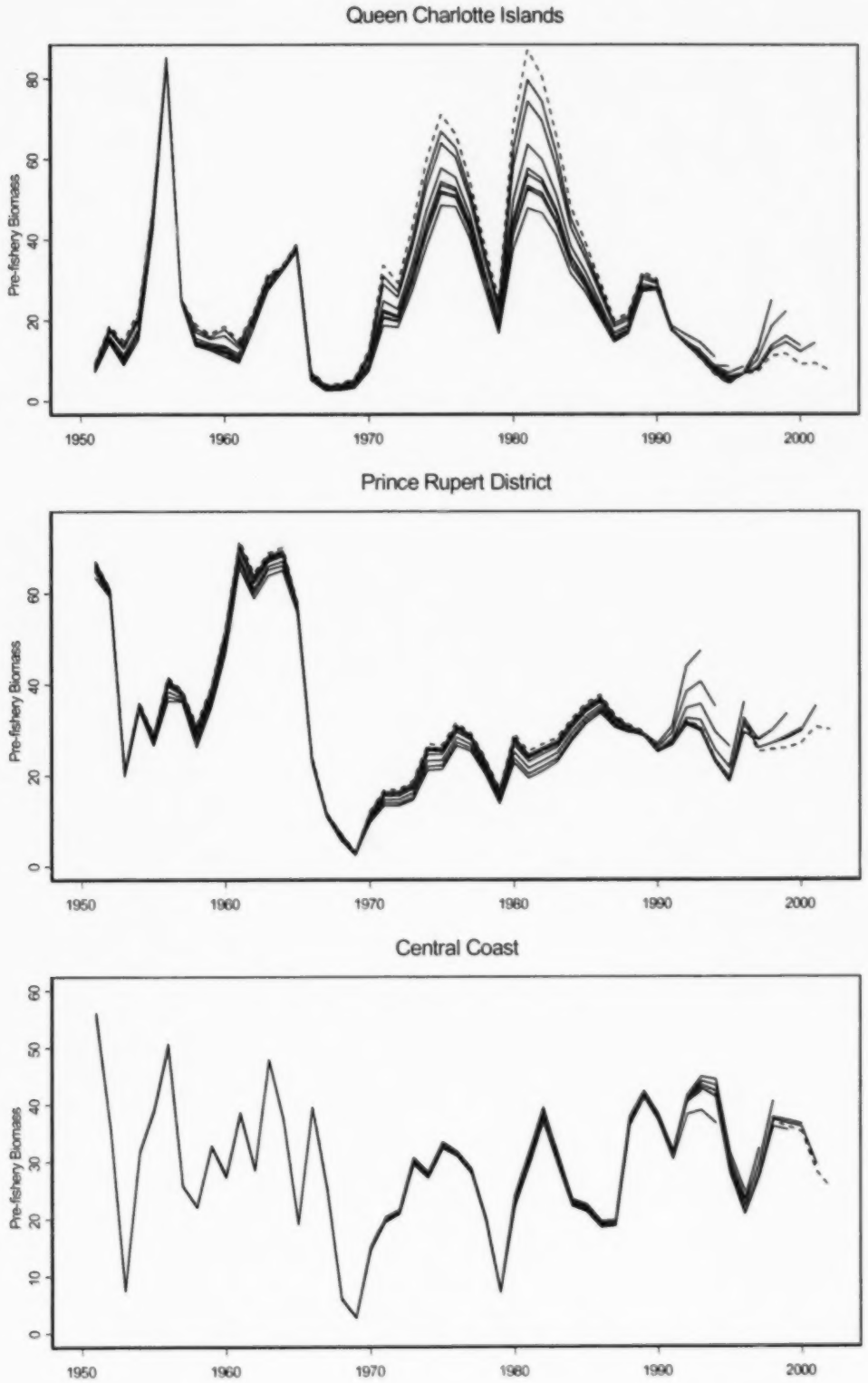

Figure 4.12. Retrospective analysis of estimated spawning biomass (tonnes x 1000) for northern B.C. herring stocks from 1951-2002. Dashed line indicates the most recent assessment.

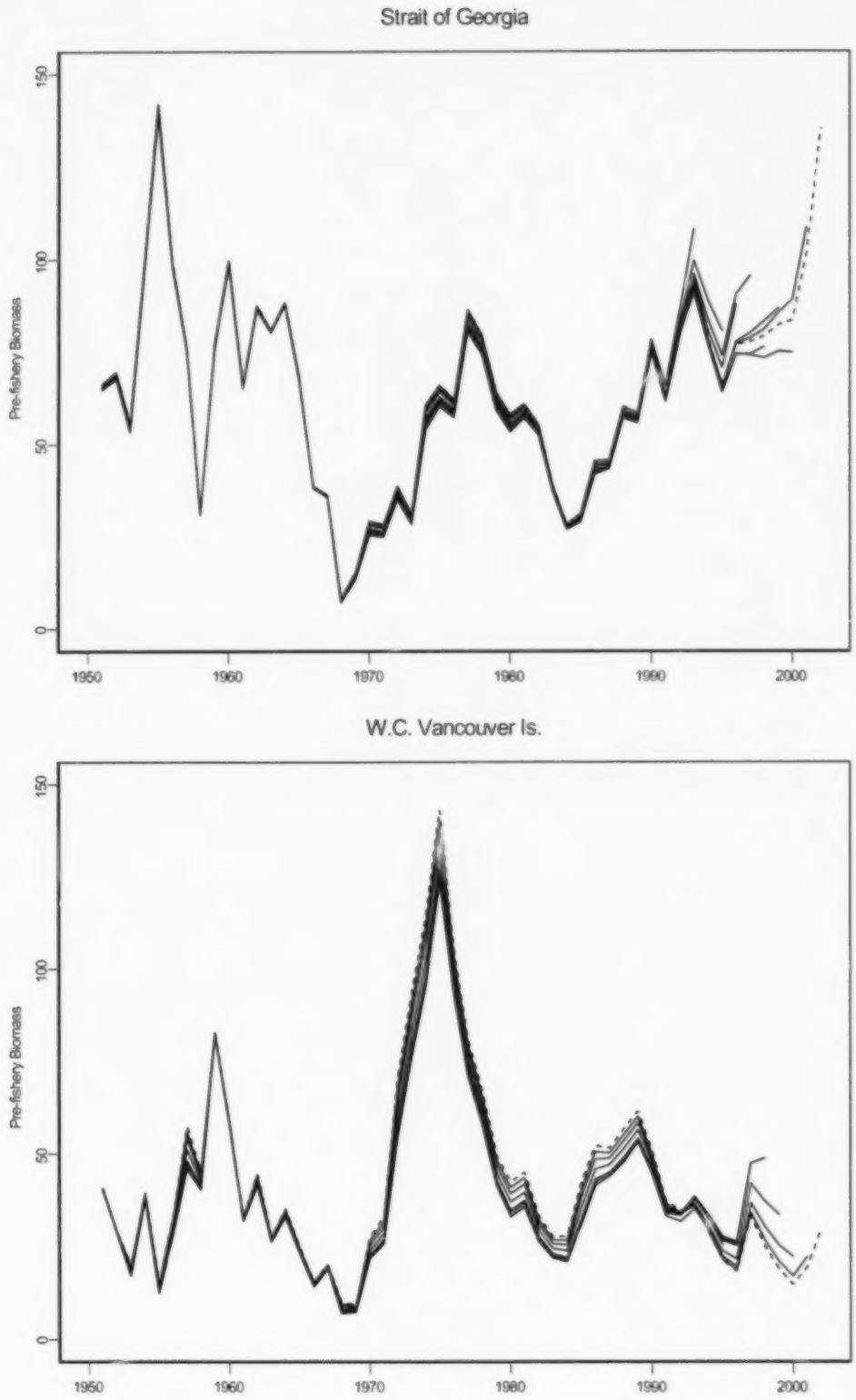

Figure 4.13. Retrospective analysis of estimated spawning biomass (tonnes x 1000) for southern B.C. herring stocks from 1951-2002. Dashed line indicates the most recent assessment.

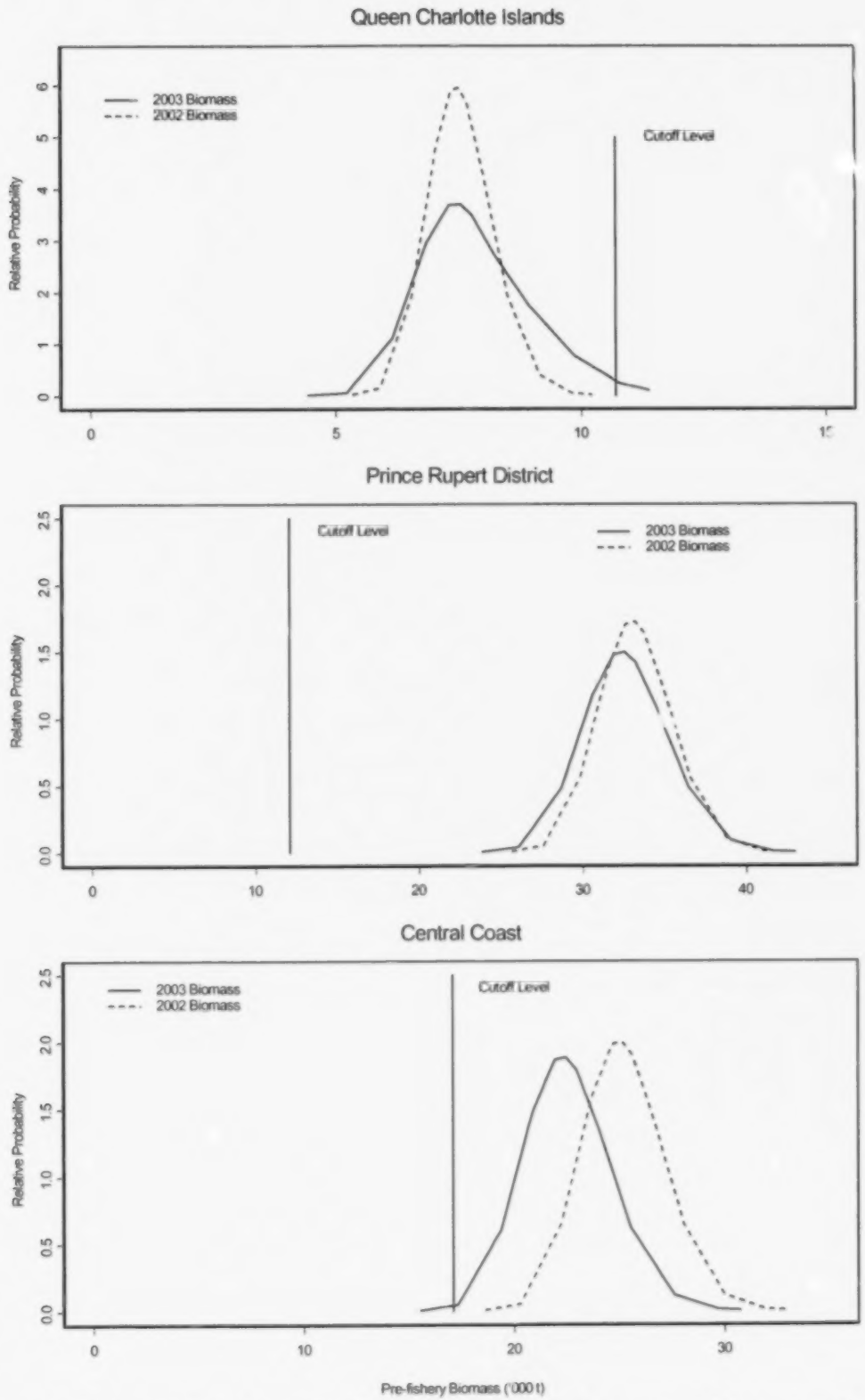

Figure 4.14. Estimated Bayesian profile likelihood distributions for current and forecast pre-fishery biomass for the northern stock assessment regions.

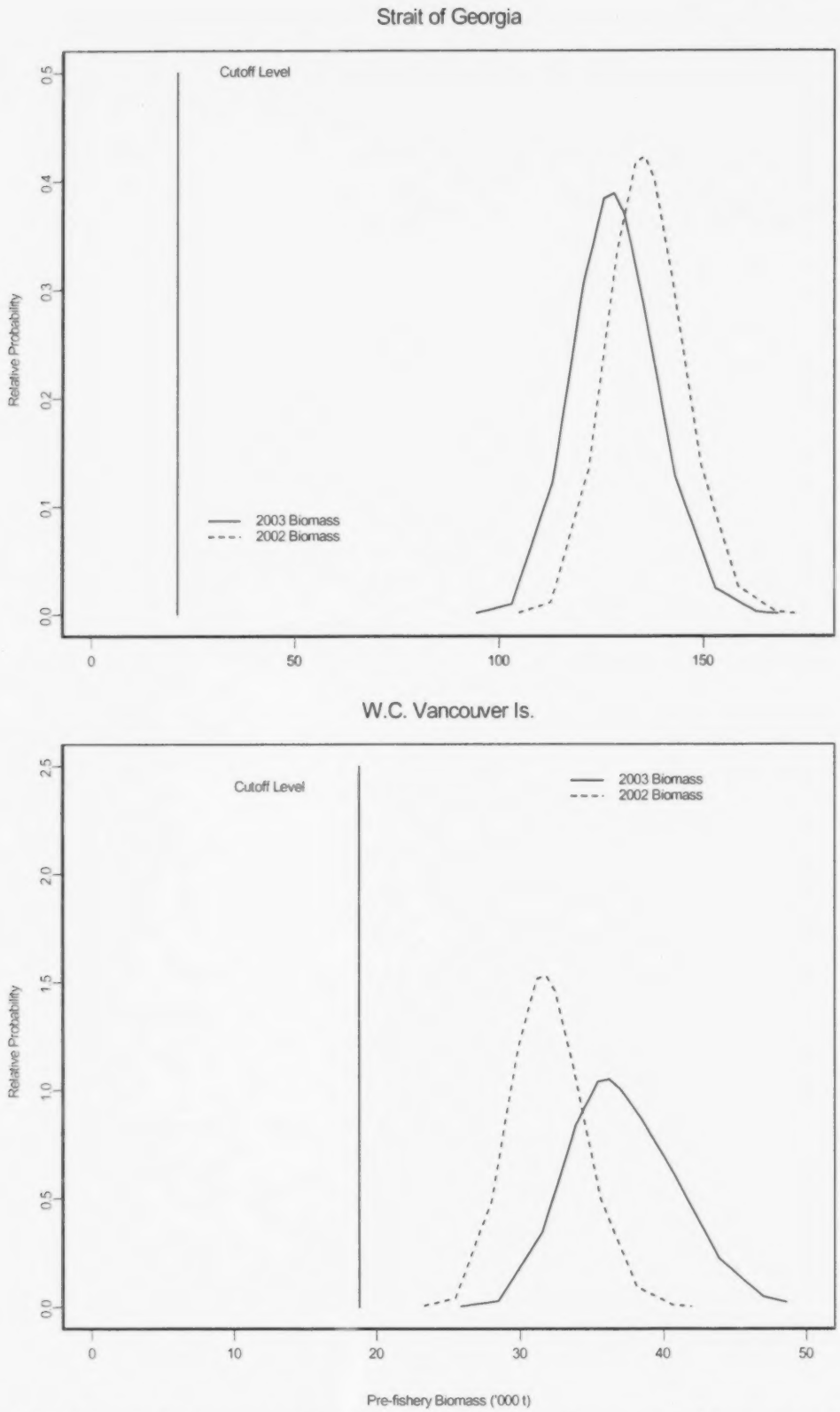

Figure 4.15. Estimated Bayesian profile likelihood distributions for current and forecast pre-fishery biomass for the southern stock assessment regions.

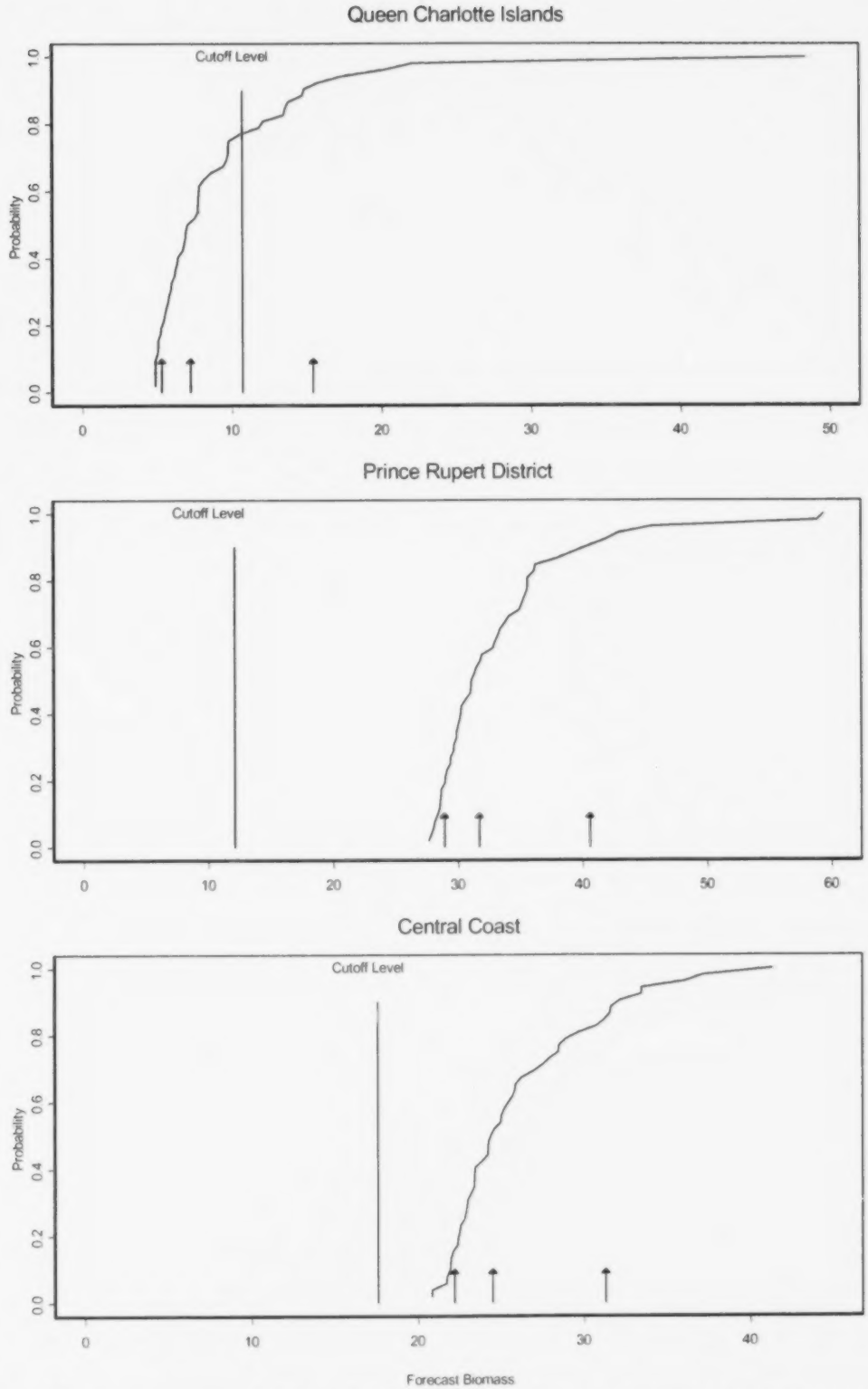

Figure 4.16. Cumulative probability distributions of forecast spawning biomass (tonnes x 1000) for northern B.C. herring stock assessment regions in 2003. Arrows represent forecasts assuming poor, average, and good recruitment.

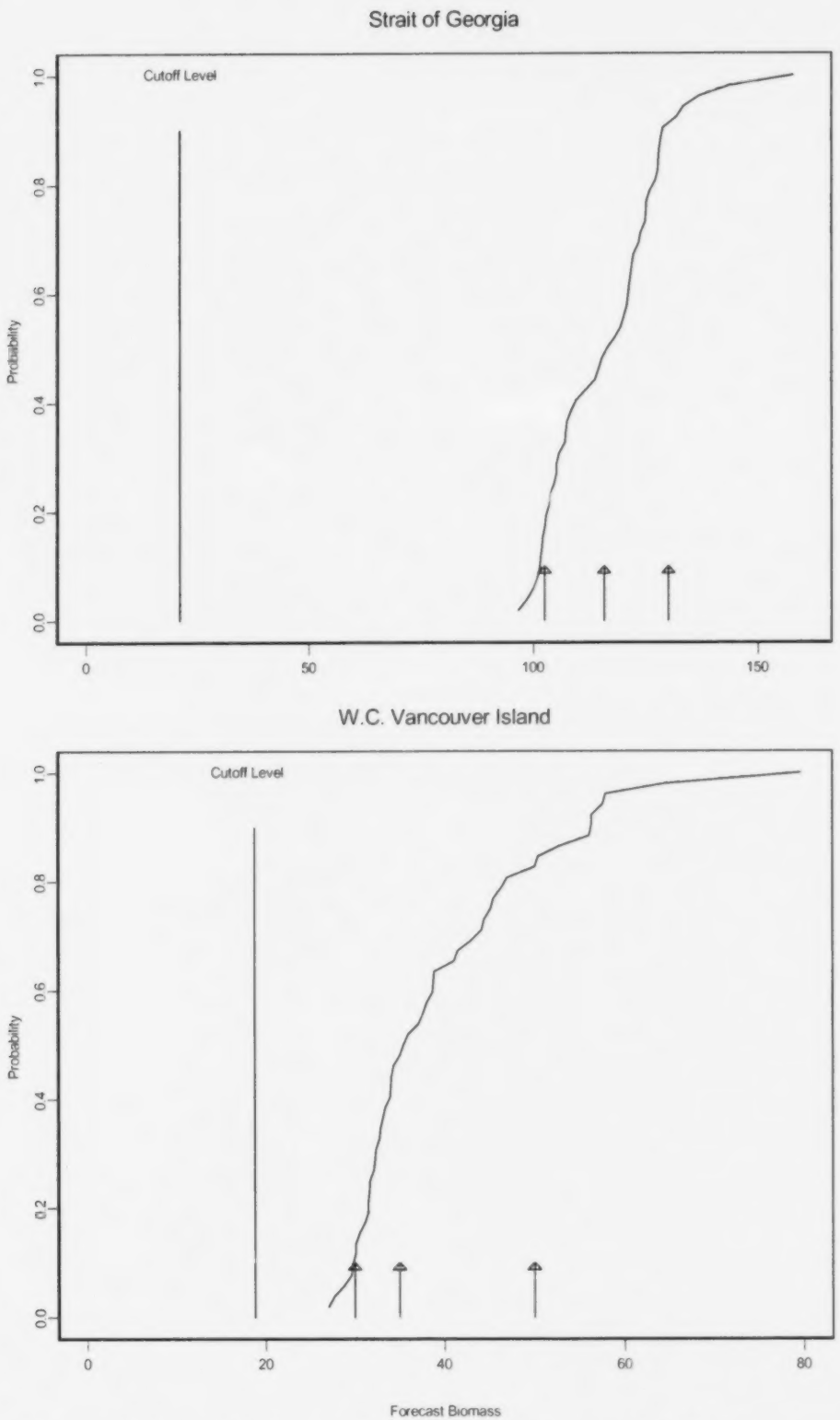

Figure 4.17. Cumulative probability distributions of forecast spawning biomass (tonnes x 1000) for southern B.C. herring stock assessment regions in 2003. Arrows represent forecasts assuming poor, average, and good recruitment.

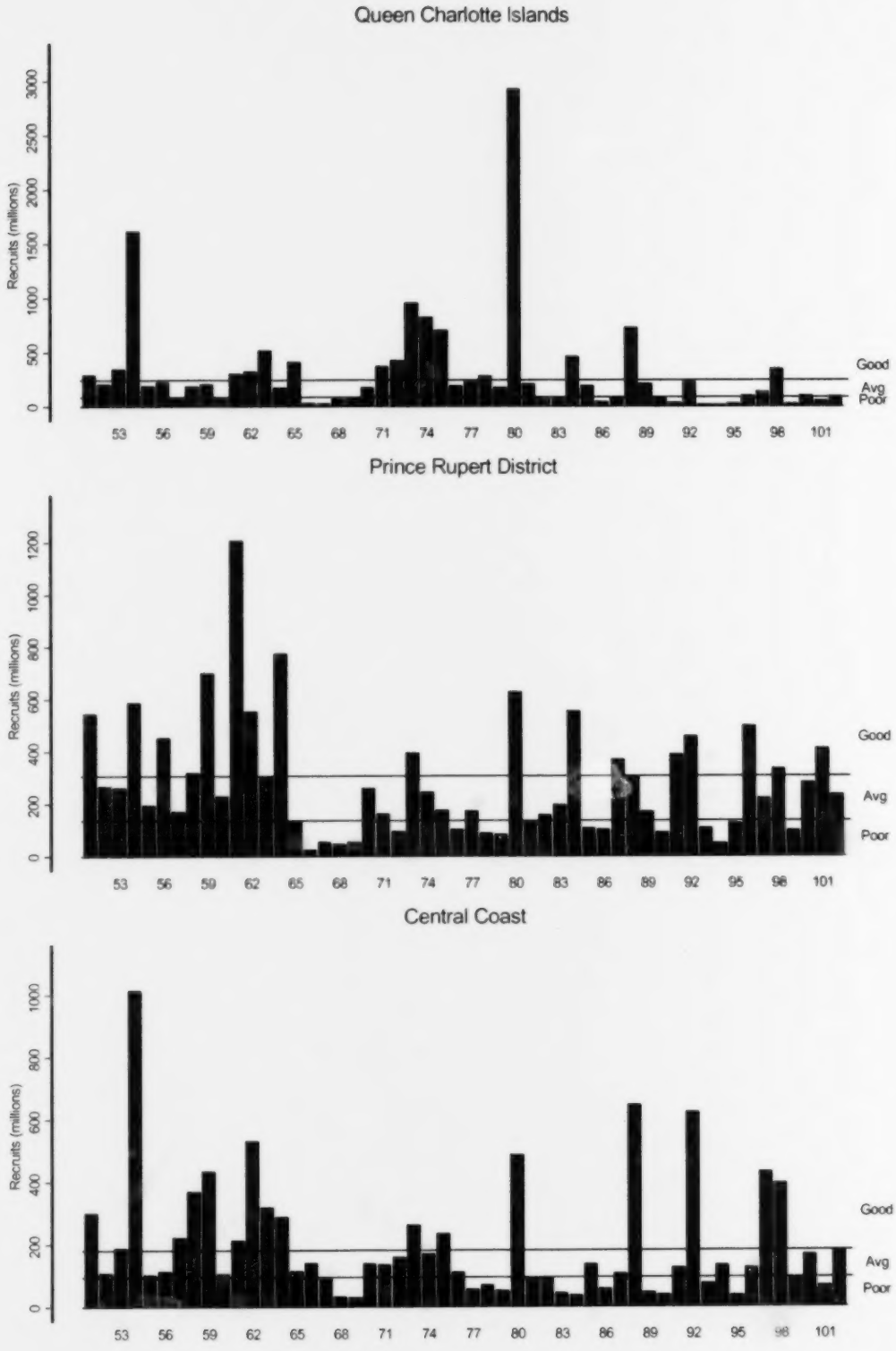

Figure 4.18. Estimates of abundance of recruiting age 2+ year-classes from age-structured analysis for northern B.C. herring stock assessment regions, 1951-2002. The horizontal lines delimit poor, average, and good recruitment categories and are the 33 and 66 percentiles of the cumulative frequency distribution.

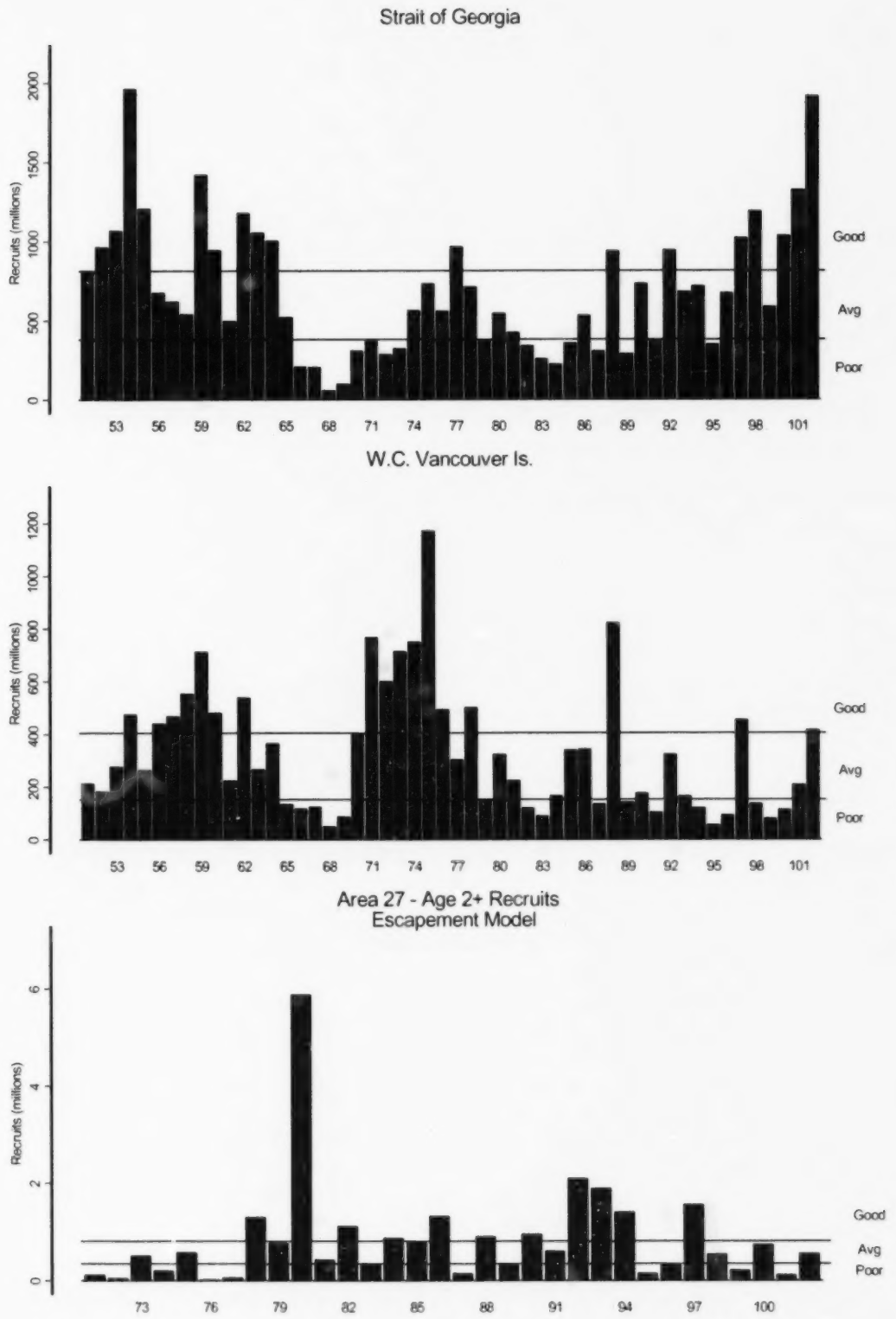

Figure 4.19. Estimates of abundance of recruiting age 2 year-classes from age-structured analysis for southern B.C. herring stock assessment regions, 1951-2002. The horizontal lines delimit poor, average, and good recruitment categories and are the 33 and 66 percentiles of the cumulative frequency distribution.

Queen Charlotte Islands

The stock reconstruction for the Queen Charlotte Islands region indicates peaks in abundance during the mid-1950s, 1970s, and 1980s followed by a recent protracted decline (Fig. 4.1). Similar trends in stock biomass are observed using the historical or new input data sets. Fitting a single fixed q to the entire time series results in lower abundance estimates for the 1970s and 1980s but does not alter the estimate of current stock level (Fig. 4.3). Residuals from the spawn and age composition data do not indicate any major lack of fit to the model in recent years (Fig. 4.5, 4.7). The retrospective analysis for this stock suggests considerable uncertainty about abundance levels during the 1970s and 1980s with a general tendency to under estimate abundance relative to the current assessment. However, in recent years there is an indication that the model has produced optimistic abundance forecasts (Fig. 4.12)

The profile likelihood indicates that abundance in 2002 was between 5 and 10,000 tonnes and projections for 2003 are anticipated to be of a similar magnitude (Fig. 4.14). Both these levels fall well below the Cutoff of 10,700 tonnes for this assessment region. The estimated spawning biomass is among the smallest observed for this area and raises questions about the distribution of the stock given the encouraging spawning in 2001. Unusual weather conditions in 2002 led to later than usual spawning in many areas and may have resulted in undetected spawning or movement of fish to other areas. The cumulative probability distributions for the 2003 forecast suggest an 80% likelihood that abundance will be below Cutoff (Fig. 4.16). Only a good recruitment would bring abundance above the fishery threshold for this assessment region. Recruitment to this stock has been generally poor for the past decade with only one good year-class in 1995 (Fig. 4.11). The spawning run was again composed primarily of young fish with ages 2-4 constituting almost 70% of the spawners (Appendix 1.1). While this is encouraging for stock rebuilding it appears that many are not surviving long enough to make a contribution to the spawning population. The forecast run size to the Queen Charlotte Islands in 2003 is 5300 tonnes with a poor recruitment and 7200 tonnes with an average recruitment (Table 4.3). No harvest is recommended in this region in 2003.

Prince Rupert District

The stock reconstruction for the Prince Rupert District indicates minor fluctuations in abundance since the rebuilding of the stock in the early 1970s with a relatively stable level since the early 1980s (Fig. 4.1). Similar trends in stock biomass are observed using the historical or new input data sets although the new data series results in a slightly lower average abundance. Fitting a single fixed q to the entire time series does not result in markedly different abundance estimates, suggesting that the q estimated for the pre-dive survey era is close to 1 and implies that spawn assessments have likely been fairly comprehensive in this area (Fig. 4.3). Residuals from the spawn data indicate good fit to the model but there is a slight downward trend over time suggesting an overestimation of spawn in the reduction period relative to the present (Fig. 4.5). The age composition data does not indicate any major lack of fit to the model in recent years although there are some large residuals from the fall samples in the early 1980s (Fig. 4.8). The retrospective analysis for this stock indicates some minor variations in estimated abundance during much of the time series, with a general tendency to under estimate abundance relative to the current assessment from 1970-1990. However, in recent years the model abundance forecasts have been higher than suggested by the current assessment (Fig. 4.12).

The profile likelihood indicates that abundance in 2002 was between 25 and 35,000 tonnes and projections for 2003 are anticipated to be of a similar magnitude (Fig. 4.14). Both these levels are well above the Cutoff of 12,100 tonnes for this assessment region. The cumulative probability distributions for the 2003 forecast suggest that a poor to average recruitment will result in a run size of 25

to 30,000 tonnes, similar to 2002 (Fig. 4.16). Recruitment to this stock has been consistent, with good year-classes occurring roughly ever 4 years since 1980 (Fig. 4.18). The spawning run consisted of a broad range of age-classes with recruits accounting for 20% of the total (Appendix 1.1). A substantial number of age 1+ fish were also observed in the run (6.5%). The forecast run size to the Prince Rupert District in 2003 with average recruitment is 31,660 tonnes resulting in a potential harvest of 6,330 tonnes (Table 4.3).

Central Coast

The stock reconstruction for the Central Coast indicates moderate fluctuations in abundance since the rebuilding of the stock in the early 1970s with a slightly increasing trend to the mid-1990s (Fig. 4.1). The fluctuations appear to be associated with the recruitment of strong year-classes. Virtually identical trends in stock biomass are observed using the historical or new input data sets. Similarly, fitting a single fixed q to the entire time series does not result in markedly different abundance estimates, suggesting that the q estimated for the pre-dive survey era is close to 1 and that spawn assessments have been fairly comprehensive in this area (Fig. 4.3). Residuals from the spawn data indicate good fit to the model declining substantially over time (Fig. 4.5). The age composition data does not indicate any major lack of fit to the model in recent years although there are some significant residuals from the gillnet fishery in the past few years (Fig. 4.9). The retrospective analysis for this stock indicates little or no variation in estimated abundance during the entire time series. There are no indications of over or under forecasting relative to the current assessment (Fig. 4.12).

The profile likelihood indicates that abundance in 2002 was between 20 and 30,000 tonnes and projections for 2003 are anticipated to be slightly lower (Fig. 4.14). The projected abundance remains above the Cutoff of 17,600 tonnes for this assessment region. The cumulative probability distributions for the 2003 forecast suggest that even with little or no recruitment abundance will remain above the Cutoff level, and with a poor to average recruitment stock size will likely be between 20 to 25,000 tonnes (Fig. 4.16). Recruitment to this stock has been characterized by intermittent strong year-classes with the last good ones being 1994 and 1995 (Fig. 4.18). The recruiting 1999 year-class is average to good, accounting for 30% of the spawning run and may be stronger than initially appears (Appendix 1.1). The forecast run size to the Central Coast in 2003 with average recruitment is 25,300 tonnes, resulting in a potential harvest of 5,050 tonnes.

Strait of Georgia

The Strait of Georgia herring stock remains the most productive on the coast. Stock reconstruction for the Strait of Georgia indicates that abundance has increased steadily since the fishery closure of the mid-1980s (Fig. 4.2). Virtually identical trends in stock biomass are observed using the historical or new input data sets. Similarly, fitting a single fixed q to the entire time series results in similar estimates of abundance although estimates for a single fixed q are higher than for those with a separate q estimated for the pre-dive survey era (Fig. 4.4). Residuals from the spawn data indicate good fit to the model particularly since the early 1990s (Fig. 4.6). The age composition data does not indicate any major lack of fit to the model over the time series although there are some large residuals for age 2 fish in the fall food fishery since the mid-1970s (Fig. 4.10).The retrospective analysis for this stock indicates little or no variation in estimated abundance during most of the time series, and no consistent indication of over or under forecasting relative to the current assessment (Fig. 4.13).

The profile likelihood indicates that abundance in 2002 was between 120 and 160,000 tonnes and projections for 2003 are anticipated to be slightly lower (Fig. 4.15). The projected abundance remains well above the Cutoff of 21,200 tonnes for this assessment region. The cumulative probability distributions for the 2003 forecast suggest that even with little or no recruitment, abundance will remain above 100,000 tonnes and with a poor to average recruitment, stock size will likely be between 100 to 125,000 tonnes (Fig. 4.17). Recruitment to this stock has been characterized by consistent strong year-classes every second or third year since the mid-1980s (Fig. 4.19). The recruiting 1999 year-class appears to be among the largest ever observed in this assessment region accounting for 50% of the spawning run in 2002 (Appendix 1.1). The forecast run size to the Strait of Georgia in 2003 with average recruitment is 115,670 tonnes resulting in a potential harvest of 23,130 tonnes.

West Coast Vancouver Island

Abundance in the west coast of Vancouver Island assessment region has fluctuated dramatically from the historic high of the mid-1970s to the recent depressed levels (Fig. 4.2). As with most of the other stocks, virtually identical trends in stock biomass are observed using the historical or new input data sets. Fitting a single fixed q to the entire time series resulted in identical estimates of abundance with the q fitted to the pre-dive era being estimated at 0.99, identical to the fixed value of 1.0 for the dive era (Fig. 4.4). Residuals from the spawn data indicate reasonable fit to the model with some large residuals throughout the time series (Fig. 4.6). The age composition residuals indicate a good fit throughout the time series with only a few large residuals during the gillnet fisheries of the late-1970s (Fig. 4.11). The retrospective analysis for this stock indicates slight variation in estimated abundance during the 1970s and 1980s with a tendency to underestimate relative to the current view of the historical abundance but with a recent trend to over forecasting since the mid-1990s (Fig. 4.13).

The profile likelihood indicates that abundance in 2002 was between 27 and 35,000 tonnes and projections for 2003 are anticipated to be somewhat higher (Fig. 4.15). The projected abundance is well above the Cutoff of 18,800 tonnes for this assessment region, and indicates that the rebuilding trend observed last year is continuing. The cumulative probability distributions for the 2003 forecast suggest that even with little or no recruitment abundance will exceed 25,000 tonnes and with a poor to average recruitment stock size will likely be between 30 to 35,000 tonnes (Fig. 4.17). Recruitment to this stock has been characterized by periods of good and bad recruitment prior to 1980. Subsequently, average or better year-classes have been intermittent occurring about every 4-5 years (Fig. 4.19). The recruiting 1999 year-class appears to be above average accounting for 53% of the spawning run (Appendix 1.1). The anticipated recruitment in 2003 based on the offshore survey is poor (Appendix 3). Therefore, the forecast run size to the west coast of Vancouver Island in 2003, with poor recruitment, is 30,030 tonnes resulting in a potential harvest of 6,010 tonnes.

Minor Stocks

A forecast of run size is not available for the minor stocks in Area 27. However, based on recent harvesting policy for this area, a quota of no more than 10% of the estimated 2002 biomass is recommended. The estimated spawning biomass of 852 tonnes in 2002 (Table 2.1), yields a maximum potential harvest of 85 tonnes for the area.

Similarly, the limited spawn assessment in Area 2W indicated a biomass of 134 tonnes in 2002, resulting in a potential harvest of 13 tonnes for 2003 (Table 2.1).

Table 4.3. Summary of 2003 abundance forecast, Cutoff levels, and potential harvest given poor, average, and good age 2^{+} recruitment for each of the assessment regions. The 95% confidence interval for the profile likelihood is also presented.

Assessment Regions	Abundance Forecast			P.L. 95% C.I.	Cutoff Level	Potential Harvest		
	Poor	Avg	Good			Poor	Avg	Good
Queen Charlotte Is.	5.29	7.20	15.37	5.8-10.4	10.70	0.00	0.00	3.07
Prince Rupert District	28.94	31.66	40.58	27.0-38.3	12.10	5.79	6.33	8.12
Central Coast	22.93	25.26	31.99	18.7-27.9	17.60	4.59	5.05	6.40
Strait of Georgia	102.44	115.67	130.01	106.6-150.1	21.20	20.49	23.13	26.00
W.C. Vancouver Island	30.03	35.11	50.35	29.7-45.2	18.80	6.01	7.02	10.07

* Available harvest is the forecast-Cutoff to maintain stock at or above the Cutoff level.

5. SIZE AT AGE TRENDS

Interannual changes in growth rate of herring can have significant impacts on the size at age and consequently on the estimates of stock productivity and availability to the harvesting sectors. Recent concerns about declining size of herring in the late 1990s have ameliorated but no obvious trends in size at age are evident from recent data (Fig. 5.1). Size at age trends continue to be of interest and since 1999 have been incorporated into the management decision making process to adjust the potential harvest based on the proportion of the stock catchable by the gillnet sector.

ACKNOWLEDGEMENTS

Chuck Fort and Peter Midgley updated the catch, biological sampling and spawn survey data bases and reviewed all 2002 assessment data. Howard Stiff provided programming support for the Access databases used to summarize the assessment data series. Database upgrades were funded by the Herring Conservation and Research Society (HCRS). The HCRS through the test fishing program also funded the collected spawn survey information and biological samples coastwide.

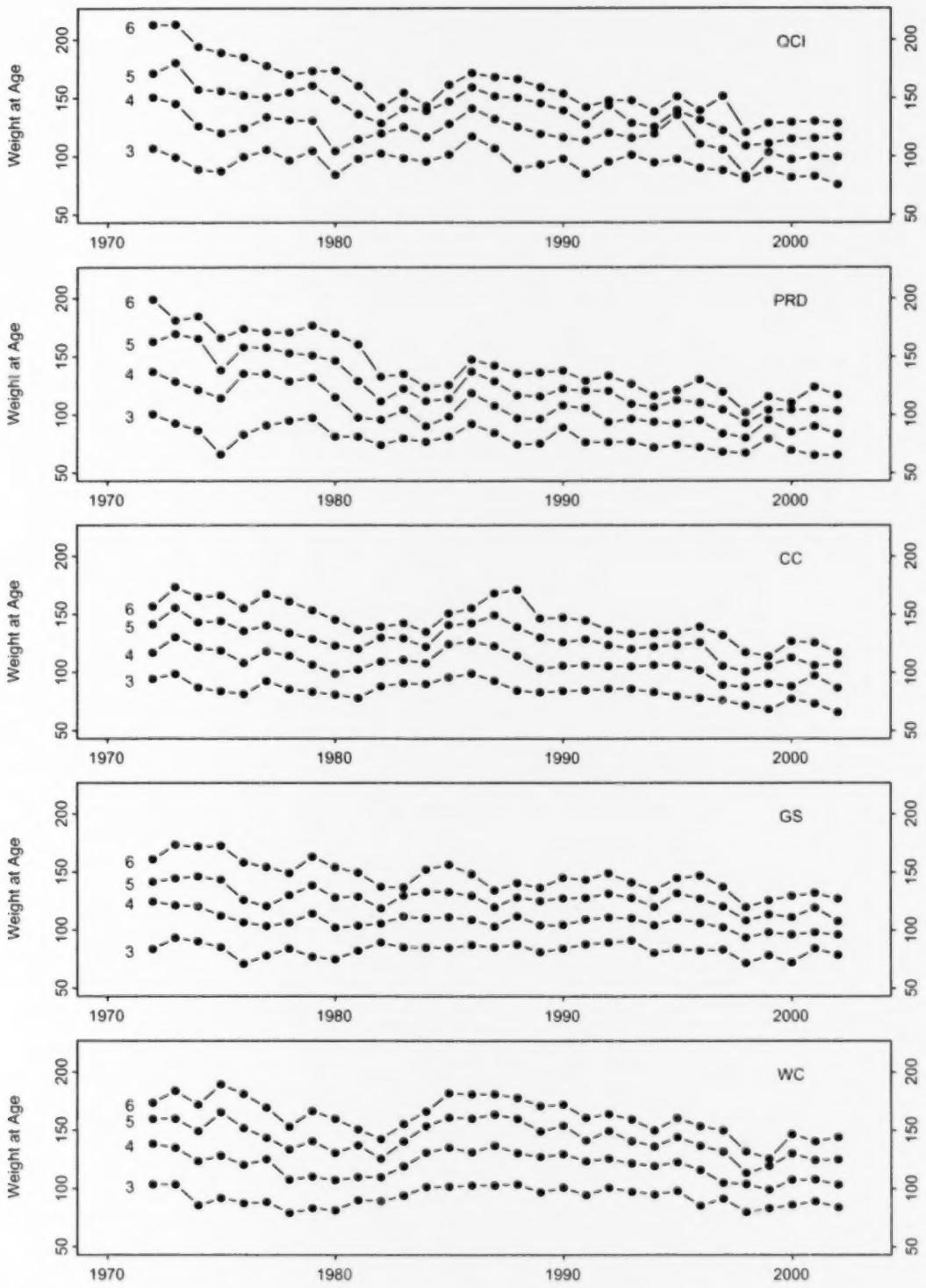

Figure 5.1. Estimates of weight-at-age (g) for 3-6 year old herring from 1951-2002 for the five major assessment regions.

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7. APPENDIX TABLES

Appendix 1.1. Age composition and catch by season, fishery and gear type for the Queen Charlotte Islands stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE									Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19501	Jan-Apr	Seine	0.00	0.07	15.31	52.91	15.31	11.52	4.20	0.61	0.07	0.00	89.7	1,476		2,847	31.744
19512	Jan-Apr	Seine	1.92	24.77	20.96	29.67	17.98	3.71	0.93	0.07	0.00	0.00	78.4	2,251		10,147	122.347
19534	Jan-Apr	Seine	0.06	2.90	29.02	21.28	33.66	10.19	1.93	0.71	0.19	0.06	77.1	0	*	1,786	23.168
19545	Oct-Dec	Seine	0.00	8.74	14.08	39.42	18.06	14.85	4.37	0.29	0.10	0.10	94.1	0	*	99	1.047
	Jan-Apr	Seine	0.00	8.74	14.08	39.42	18.06	14.85	4.37	0.29	0.10	0.10	94.1	0	*	1,136	12.066
19556	Jan-Apr	Seine	0.00	0.15	16.02	9.64	62.17	8.38	2.74	0.74	0.00	0.15	118.2	1,348		77,681	657.044
19567	Jan-Apr	Seine	0.07	20.71	24.66	15.96	9.38	26.29	2.37	0.44	0.11	0.00	103.3	4,423		23,711	227.806
19578	Oct-Dec	Seine	0.00	81.58	16.68	1.26	0.18	0.14	0.14	0.00	0.00	0.00	52.1	2,769	+	721	13.844
	Jan-Apr	Seine	0.00	81.98	16.24	1.29	0.20	0.16	0.12	0.00	0.00	0.00	51.8	2,475		10,426	201.343
	May-Sep	Seine	0.00	81.58	16.68	1.26	0.18	0.14	0.14	0.00	0.00	0.00	52.1	2,769	+	19	0.357
19589	Oct-Dec	Seine	0.00	1.05	63.16	28.42	7.37	0.00	0.00	0.00	0.00	0.00	92.8	95	+	199	2.140
	Jan-Apr	Seine	0.00	1.05	63.16	28.42	7.37	0.00	0.00	0.00	0.00	0.00	92.8	95	+	6,828	73.560
19601	Jan-Apr	Seine	0.00	4.21	32.63	36.00	24.84	1.26	0.42	0.21	0.42	0.00	97.7	0	*	576	5.901
	May-Sep	Seine	0.00	4.21	32.63	36.00	24.84	1.26	0.42	0.21	0.42	0.00	97.7	0	*	77	0.789
19612	Jan-Apr	Seine	0.00	2.57	38.97	44.12	5.88	7.35	0.74	0.37	0.00	0.00	114.0	272	+	7,632	66.952
19623	Jan-Apr	Seine	0.00	0.37	50.00	27.11	18.16	2.11	1.99	0.00	0.12	0.12	109.5	804		14,705	134.232
	May-Sep	Seine	0.00	0.37	50.00	27.11	18.16	2.11	1.99	0.00	0.12	0.12	109.5	804	+	275	2.508
19634	Jan-Apr	Seine	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490		28,600	251.046
	Jan-Apr	Trawl	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490	+	46	0.401
	May-Sep	Seine	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490	+	131	1.154
19645	Jan-Apr	Seine	0.00	1.71	82.31	10.25	3.63	1.34	0.55	0.20	0.00	0.00	101.5	1,019		35,304	348.556
	May-Sep	Seine	0.00	1.67	81.75	10.30	4.02	1.47	0.59	0.20	0.00	0.00	102.0	1,019	+	145	1.419
19656	Jan-Apr	Seine	0.00	18.36	32.77	16.38	10.40	7.45	5.89	4.92	2.07	1.75	130.7	0	*	2,746	21.016
19667	Jan-Apr	Seine	0.00	0.88	67.25	26.49	2.65	2.72	0.00	0.00	0.00	0.00	113.0	0	*	213	1.883
19678	Jan-Apr	Seine	0.00	29.95	50.57	17.23	2.25	0.00	0.00	0.00	0.00	0.00	94.9	0	*	80	0.843
19701	Jan-Apr	Seine	0.00	6.50	50.40	29.30	8.00	4.30	0.80	0.50	0.20	0.00	118.1	0	*	102	0.861
19712	Jan-Apr	Seine	0.00	3.59	34.24	40.98	12.30	5.57	2.14	0.77	0.35	0.06	142.1	1,184		3,972	27.954
19723	Jan-Apr	Seine	0.00	0.20	32.91	18.91	32.99	11.77	2.10	1.13	0.00	0.00	140.7	1,726		7,520	49.735
19734	Jan-Apr	Gillnet	0.00	0.00	5.73	48.41	25.48	16.56	3.18	0.00	0.00	0.64	153.8	157	+	127	0.824
	Jan-Apr	Seine	0.00	0.12	27.40	41.39	17.67	10.64	2.32	0.40	0.06	0.00	126.8	1,215		6,191	47.881
19745	Jan-Apr	Gillnet	0.00	0.00	0.00	22.50	40.00	30.00	5.00	2.50	0.00	0.00	169.3	40	+	105	0.619
	Jan-Apr	Seine	0.00	0.62	27.82	36.04	24.53	8.53	1.94	0.40	0.12	0.00	132.8	6,010		7,602	60.181
	May-Sep	Seine	0.00	0.13	33.28	45.41	13.55	5.29	1.72	0.46	0.17	0.00	116.3	3,026	+	17	0.147
19756	Jan-Apr	Gillnet	0.00	0.00	0.00	0.75	21.80	60.90	14.29	2.26	0.00	0.00	196.2	133	+	1,802	9.186
	Jan-Apr	Other	0.00	0.44	2.81	36.87	29.25	23.18	6.41	0.96	0.07	0.00	151.8	4,055	+	341	2.247
	Jan-Apr	Seine	0.00	0.30	2.98	44.51	31.53	15.24	4.61	0.76	0.06	0.00	155.4	4,055		11,939	82.499
	May-Sep	Seine	0.00	0.44	2.81	36.87	29.25	23.18	6.41	0.96	0.07	0.00	151.8	4,055	+	374	2.466
19767	Jan-Apr	Gillnet	0.00	0.00	0.00	2.53	16.61	39.71	27.08	11.55	2.17	0.36	196.6	277	+	1,489	7.575
	Jan-Apr	Other	0.00	0.09	19.67	8.12	29.70	22.91	14.66	4.44	0.41	0.00	157.1	3,178	+	1,365	8.687
	Jan-Apr	Seine	0.00	0.05	18.42	9.26	36.66	22.74	9.92	2.64	0.31	0.00	159.1	3,178		11,125	73.628
	May-Sep	Seine	0.00	0.09	19.67	8.12	29.70	22.91	14.66	4.44	0.41	0.00	157.1	3,178	+	21	0.132
19778	Jan-Apr	Gillnet	0.00	0.00	0.00	4.17	11.81	20.14	38.89	20.14	4.17	0.69	196.9	144	+	2,553	12.967
	Jan-Apr	Other	0.00	0.17	26.28	17.24	9.56	26.54	14.08	4.95	0.94	0.26	147.5	1,172	+	819	5.554
	Jan-Apr	Seine	0.00	0.16	22.75	17.10	11.34	33.12	13.29	2.03	0.17	0.05	146.4	1,172		9,172	62.947
19789	Oct-Dec	Seine	0.00	6.22	4.91	32.53	18.23	20.31	14.19	3.06	0.44	0.11	149.9	916	+	50	0.336
	Jan-Apr	Gillnet	0.00	0.00	0.00	28.24	25.88	27.06	15.29	3.53	0.00	0.00	160.1	170	+	2,086	13.028
	Jan-Apr	Other	0.00	6.22	4.91	32.53	18.23	20.31	14.19	3.06	0.44	0.11	149.9	916	+	1,001	6.679
	Jan-Apr	Seine	0.00	7.06	5.39	32.35	18.23	20.80	12.45	3.08	0.51	0.13	148.9	779		5,817	39.078
19790	Jan-Apr	Gillnet	0.00	0.00	6.50	4.56	44.47	19.36	19.58	4.20	1.34	0.00	157.6	518		1,210	7.739
	Jan-Apr	Other	0.00	1.74	83.71	4.18	4.46	2.49	1.54	1.15	0.65	0.07	93.5	4,015	+	1,001	10.704
	Jan-Apr	Seine	0.00	0.69	83.10	4.49	5.44	2.58	1.79	1.22	0.60	0.09	97.1	2,986		2,106	22.050
19801	Jan-Apr	Gillnet	0.00	0.00	0.30	72.00	8.55	9.84	5.88	2.84	0.60	0.00	141.9	790		1,705	11.930
	Jan-Apr	Other	0.00	0.54	3.69	84.91	5.08	2.79	1.75	0.71	0.28	0.24	117.0	6,336	+	910	7.778
	Jan-Apr	Seine	0.00	0.42	3.05	85.37	5.13	3.08	1.92	0.68	0.21	0.14	116.3	5,551		3,888	32.912
	May-Sep	Seine	0.00	1.33	3.92	88.65	2.94	1.73	0.69	0.35	0.23	0.17	112.7	1,735	+	39	0.342
19812	Jan-Apr	Gillnet	0.00	0.00	0.21	3.35	89.10	3.35	2.31	1.05	0.42	0.21	141.9	477		1,407	9.918
	Jan-Apr	Other	0.00	0.85	4.68	4.48	84.32	2.47	1.53	0.99	0.54	0.14	128.0	3,526	+	1,001	7.821
	Jan-Apr	Seine	0.00	0.45	3.26	3.50	87.61	2.19	1.34	0.95	0.57	0.12	127.2	3,526		2,353	18.420
	May-Sep	Seine	0.00	0.85	4.68	4.48	84.32	2.47	1.53	0.99	0.54	0.14	128.0	3,526	+	18	0.138

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.1. Age composition and catch by season, fishery and gear type for the Queen Charlotte Islands stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19823	Jan-Apr	Gillnet	0.00	0.00	0.00	1.19	2.38	90.32	2.72	2.38	0.51	0.51	158.5	589	929	5.860
	Jan-Apr	Other	0.00	4.88	5.23	3.51	6.86	72.87	3.91	1.58	0.91	0.25	146.9	1,968 +	1,001	6.815
	Jan-Apr	Seine	0.00	4.14	4.21	3.02	5.75	77.05	3.65	1.33	0.70	0.14	148.7	1,425	4,601	30.942
	May-Sep	Seine	0.00	4.88	5.23	3.51	6.86	72.87	3.91	1.58	0.91	0.25	146.9	1,968 +	67	0.457
19834	Jan-Apr	Gillnet	0.00	0.00	2.81	1.28	4.60	8.95	80.05	1.79	0.26	0.26	154.6	391 +	535	3.459
	Jan-Apr	Other	0.00	2.70	36.39	4.54	2.87	10.10	41.76	1.12	0.34	0.17	125.5	3,484 +	1,001	7.976
	Jan-Apr	Seine	0.00	2.09	36.57	4.17	2.64	9.56	43.33	1.11	0.35	0.17	126.1	3,484	4,054	31.997
	May-Sep	Seine	0.00	2.70	36.39	4.54	2.87	10.10	41.76	1.12	0.34	0.17	125.5	3,484 +	58	0.459
19845	Jan-Apr	Gillnet	0.00	0.00	8.30	24.48	2.90	4.56	12.45	46.89	0.41	0.00	155.0	241 +	1,493	9.632
	Jan-Apr	Other	0.00	1.32	14.93	31.83	4.05	4.50	11.36	31.47	0.45	0.08	148.1	3,556 +	1,001	6.758
	Jan-Apr	Seine	0.00	0.12	8.63	25.14	3.52	3.93	12.79	45.24	0.53	0.10	146.4	3,099	4,581	27.888
	May-Sep	Seine	0.00	0.10	8.15	24.49	3.51	3.95	12.94	46.22	0.54	0.10	165.5	2,025 +	35	0.209
19856	Jan-Apr	Gillnet	0.00	0.00	0.00	12.73	53.42	4.04	5.28	9.01	15.22	0.31	159.7	322 +	890	5.576
	Jan-Apr	Other	0.00	0.22	2.83	21.27	40.02	4.33	3.68	8.23	19.03	0.40	165.5	5,055 +	1,001	6.048
	Jan-Apr	Seine	0.00	0.16	2.00	21.05	37.46	3.69	3.28	8.88	23.03	0.43	165.5	4,462	2,613	15.278
	Jan-Apr	Trawl	0.00	0.31	2.80	10.56	37.58	8.70	9.63	11.18	17.70	1.55	163.5	322	0	0.000 ~
19867	Jan-Apr	Other	0.00	1.74	10.42	5.85	24.35	37.76	3.84	4.33	5.79	5.91	157.2	3,281 +	1,001	6.366
	Jan-Apr	Seine	0.00	1.78	9.60	4.90	24.93	38.44	3.88	4.36	5.86	6.24	158.6	2,916	2,028	12.787
	May-Sep	Seine	0.00	1.74	10.42	5.85	24.35	37.76	3.84	4.33	5.79	5.91	157.2	3,281 +	33	0.210
19878	Jan-Apr	Other	0.00	3.29	53.62	8.14	4.30	11.03	13.61	1.37	1.67	2.98	120.8	1,977 +	1,000	8.277
	Jan-Apr	Seine	0.00	3.64	51.01	7.52	4.77	11.75	14.86	1.37	1.67	3.40	123.6	1,676	0	0.000 ~
	Jan-Apr	Trawl	0.00	1.33	68.11	11.63	1.66	6.98	6.64	1.33	1.66	0.66	105.4	301	0	0.000 ~
	May-Sep	Seine	0.00	1.34	41.98	5.34	3.24	14.50	22.71	1.91	1.72	7.25	136.5	524 +	32	0.232
19889	Jan-Apr	Other	0.00	2.27	17.46	66.35	4.01	1.57	3.90	2.78	0.62	1.04	120.5	3,563 +	824	6.839
	Jan-Apr	Seine	0.00	3.43	5.12	85.99	3.74	0.18	0.77	0.47	0.08	0.22	119.2	2,996	1,449	11.972
	May-Sep	Seine	0.00	1.27	31.75	45.90	4.03	2.55	7.00	4.81	1.06	1.63	117.4	1,414 +	13	0.108
19890	Jan-Apr	Gillnet	0.00	0.00	0.51	8.18	44.50	9.97	8.44	17.39	8.44	2.56	149.6	391 +	1,170	7.821
	Jan-Apr	Other	0.00	0.22	9.64	18.17	60.02	3.94	1.84	3.82	1.70	0.65	134.8	5,053 +	915	6.789
	Jan-Apr	Seine	0.00	0.14	10.61	6.53	78.55	2.43	0.33	0.85	0.34	0.23	133.9	4,769	5,542	39.649
19901	Jan-Apr	Gillnet	0.00	0.00	0.00	2.27	22.44	43.47	9.66	7.10	10.23	4.83	151.9	352 +	543	3.576
	Jan-Apr	Other	0.00	6.55	4.14	10.60	28.50	38.70	3.71	1.92	3.99	1.90	130.3	3,481 +	1,001	7.684
	Jan-Apr	Seine	0.00	5.60	4.25	10.74	33.21	33.99	3.68	2.00	4.70	1.84	127.8	2,448	3,899	30.506
	Jan-Apr	Trawl	0.00	1.06	4.26	8.51	21.28	46.81	4.26	6.38	4.26	3.19	143.0	94	0	0.000 ~
19912	Jan-Apr	Other	0.00	0.72	38.96	5.06	8.19	12.53	30.20	2.41	0.63	1.29	134.2	3,321 +	583	4.343
	Jan-Apr	Seine	0.00	1.05	30.50	4.25	8.27	4.46	48.40	2.42	0.14	0.52	143.2	3,228	2,524	16.695
	Jan-Apr	Trawl	0.00	1.08	54.84	9.68	2.15	15.05	11.83	3.23	2.15	0.00	115.6	93	0	0.000 ~
19923	Jan-Apr	Gillnet	0.00	0.00	0.00	2.27	22.44	43.47	9.66	7.10	10.23	4.83	151.9	352 +	0	0.002
	Jan-Apr	Other	0.00	0.39	3.50	60.31	4.51	6.08	12.05	11.54	1.21	0.41	128.3	3,883 +	883	6.883
	Jan-Apr	Seine	0.00	0.04	2.79	67.33	4.25	4.68	9.73	9.95	0.87	0.36	124.2	2,755	2,699	21.742
	Jan-Apr	Trawl	0.00	1.75	4.68	59.65	5.85	6.43	11.70	7.02	2.34	0.58	125.9	171	0	0.000 ~
19934	Jan-Apr	Other	0.00	6.39	3.77	5.11	49.67	10.04	9.80	10.23	4.26	0.73	129.0	1,643 +	1,092	8.467
	Jan-Apr	Seine	0.00	5.50	5.50	5.63	40.75	12.87	14.48	11.13	3.49	0.67	130.5	746	299	2.291
	Jan-Apr	Trawl	0.00	7.08	2.36	5.42	53.30	8.49	6.60	8.49	7.31	0.94	133.0	424	0	0.000 ~
19945	Jan-Apr	Seine	0.00	14.35	15.82	2.32	4.43	37.55	9.70	8.02	5.27	2.53	134.8	474	0	0.000 ~
19956	Jan-Apr	Seine	0.10	10.76	53.81	9.30	3.24	3.34	15.57	2.40	1.15	0.31	102.8	957	0	0.000 ~
19967	Jan-Apr	Other	0.00	22.64	26.17	33.41	5.23	1.52	4.44	5.36	0.85	0.37	97.5	1,643 +	214	2.194
	Jan-Apr	Seine	0.00	22.64	26.17	33.41	5.23	1.52	4.44	5.36	0.85	0.37	97.5	1,643	0	0.000 ~
19978	Jan-Apr	Other	0.00	0.37	54.12	27.91	11.60	2.69	0.66	1.22	1.10	0.33	87.8	2,716 +	818	9.322
	Jan-Apr	Seine	0.00	0.16	58.12	27.55	9.74	2.53	0.48	0.40	0.63	0.40	87.9	1,263	1,372	15.597
19989	Jan-Apr	Gillnet	0.00	0.00	0.67	30.78	22.80	29.12	9.98	2.66	1.33	2.66	131.4	601	473	3.596
	Jan-Apr	Other	0.00	4.29	2.31	63.99	17.21	8.11	2.54	0.64	0.40	0.52	105.8	2,516 +	819	7.742
	Jan-Apr	Seine	0.00	3.78	2.18	64.88	16.88	8.04	2.75	0.66	0.41	0.42	105.9	2,516	2,859	26.998
19990	Jan-Apr	Other	0.00	4.98	18.51	3.91	59.07	7.95	4.51	0.42	0.47	0.19	107.5	2,150 +	910	8.468
	Jan-Apr	Seine	0.00	3.71	17.36	3.72	60.60	8.26	5.19	0.39	0.61	0.16	108.4	2,057	1,822	17.023
20001	Jan-Apr	Other	0.00	15.26	31.65	22.32	5.06	20.92	3.05	1.39	0.26	0.09	97.0	1,147 +	408	4.207
	Jan-Apr	Seine	0.00	15.26	31.65	22.32	5.06	20.92	3.05	1.39	0.26	0.09	97.0	1,147	0	0.000 ~
20012	Jan-Apr	Other	0.00	20.46	25.49	24.00	12.54	2.92	12.61	1.43	0.44	0.10	94.7	2,942 +	910	9.608
	Jan-Apr	Seine	0.00	20.84	22.90	25.47	12.99	3.11	12.83	1.36	0.43	0.08	93.6	2,572	706	7.543

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

Season	Fishery	Gear	PERCENT AT AGE 0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged		CATCH (tonnes)	(millions)
19501	Oct-Dec	Seine	0.03	5.19	18.96	57.83	10.05	5.42	2.27	0.20	0.06	0.00	91.5	3,524		27,192	297.109
	Jan-Apr	Seine	0.09	1.72	15.86	60.43	11.38	6.21	3.79	0.43	0.00	0.09	95.8	1,160		18,674	195.022
19512	Oct-Dec	Seine	0.09	5.32	9.32	33.19	45.08	5.66	0.91	0.40	0.03	0.00	121.7	3,498		42,613	350.112
	Jan-Apr	Seine	0.00	3.96	8.08	34.32	45.41	6.84	1.19	0.16	0.04	0.00	115.7	2,427		9,650	83.415
	May-Sep	Seine	0.05	4.76	8.81	33.65	45.22	6.14	1.03	0.30	0.03	0.00	119.2	5,925	+	116	0.976
19523	Oct-Dec	Seine	0.00	1.46	38.05	28.90	26.40	4.99	0.21	0.00	0.00	0.00	114.7	481		401	3.491
	Jan-Apr	Seine	0.00	1.07	38.17	20.04	24.95	14.29	1.39	0.11	0.00	0.00	107.7	938		1,465	13.601
19534	Oct-Dec	Seine	0.00	0.38	22.98	31.95	27.13	14.48	2.52	0.56	0.01	0.00	114.3	2,138		26,692	232.215
	Jan-Apr	Seine	0.00	8.88	47.88	19.11	13.51	6.76	3.28	0.58	0.00	0.00	83.9	518		584	6.969
19545	Jan-Apr	Seine	0.00	2.25	4.08	70.30	15.80	6.01	1.34	0.22	0.00	0.00	105.2	1,131		17,806	167.544
19556	Oct-Dec	Seine	0.00	10.04	58.11	9.51	18.95	2.55	0.53	0.18	0.12	0.00	83.6	1,683	+	1,602	19.164
	Jan-Apr	Seine	0.00	8.99	59.62	9.14	18.79	2.65	0.66	0.07	0.07	0.00	84.6	1,357		8,580	101.455
19567	Oct-Dec	Seine	0.00	18.02	19.80	35.57	12.24	13.25	0.90	0.22	0.00	0.00	93.8	3,172	+	820	9.056
	Jan-Apr	Seine	0.00	3.83	19.26	42.33	13.46	19.05	1.61	0.41	0.05	0.00	104.8	2,784		19,753	182.450
	Jan-Apr	Trawl	0.00	4.08	21.43	52.04	12.24	10.20	0.00	0.00	0.00	0.00	88.3	98		0	0.000 ~
	May-Sep	Seine	0.00	0.00	7.11	44.95	37.16	9.17	1.38	0.23	0.00	0.00	106.7	436		7,461	69.921
19578	Oct-Dec	Seine	0.00	58.55	24.14	6.24	7.24	0.80	3.02	0.00	0.00	0.00	62.7	497	+	1,270	20.260
	Jan-Apr	Seine	0.00	58.55	24.14	6.24	7.24	0.80	3.02	0.00	0.00	0.00	62.7	497	+	667	10.640
	May-Sep	Seine	0.00	58.55	24.14	6.24	7.24	0.80	3.02	0.00	0.00	0.00	62.7	497	+	2,586	41.259
19589	Oct-Dec	Seine	0.00	1.64	62.11	19.52	5.96	7.16	2.05	1.54	0.01	0.00	98.0	1,592	+	1,629	16.406
	Jan-Apr	Seine	0.00	2.88	61.03	19.34	5.06	7.96	1.81	1.85	0.06	0.00	97.5	1,454		5,629	57.722
	Jan-Apr	Trawl	0.00	3.39	58.98	20.35	5.15	8.73	1.44	1.88	0.06	0.00	97.5	1,592	+	66	0.674
	May-Sep	Seine	0.00	1.17	62.96	19.29	6.19	6.74	2.21	1.44	0.56	0.00	98.7	1,592	+	2,899	29.047
19590	Oct-Dec	Seine	0.00	62.74	8.21	20.55	5.57	1.63	1.10	0.08	0.12	0.00	64.7	1,549		3,125	49.715
	Oct-Dec	Trawl	0.00	59.38	7.49	23.25	6.10	2.21	1.17	0.22	0.19	0.00	64.7	3,166	+	72	1.110
	Jan-Apr	Seine	0.00	66.74	7.43	18.52	4.46	1.48	0.94	0.22	0.22	0.00	61.5	1,617		12,513	218.740
	Jan-Apr	Trawl	0.00	59.38	7.49	23.25	6.10	2.21	1.17	0.22	0 19	0.00	64.7	3,166	+	468	7.238
	May-Sep	Seine	0.00	5.00	3.26	51.30	20.22	10.65	7.39	1.96	0.22	0.00	115.5	460		2,297	19.897
19601	Oct-Dec	Seine	0.00	13.33	69.22	4.76	9.50	2.44	0.44	0.25	0.06	0.00	80.6	1,729		14,879	183.842
	Jan-Apr	Seine	0.00	8.10	60.17	6.91	18.06	4.38	1.74	0.43	0.20	0.00	93.8	2,174		24,244	278.906
	Jan-Apr	Trawl	0.00	10.25	60.16	7.07	16.63	3.97	1.38	0.41	0.13	0.00	86.7	3,903	+	3,273	37.756
	May-Sep	Seine	0.00	10.08	59.51	7.23	17.13	4.07	1.43	0.42	0.13	0.00	93.9	3,903	+	350	4.012
19612	Oct-Dec	Seine	0.00	6.70	32.01	38.46	7.44	11.41	2.23	0.74	0.74	0.25	106.6	403	+	633	5.938
	Oct-Dec	Trawl	0.00	6.05	30.85	38.31	7.66	11.69	3.43	0.60	1.01	0.40	109.0	496	+	296	2.714
	Jan-Apr	Seine	0.00	6.70	32.01	38.46	7.44	11.41	2.23	0.74	0.74	0.25	106.6	403	+	25,352	237.877
	Jan-Apr	Trawl	0.00	6.05	30.85	38.31	7.66	11.69	3.43	0.60	1.01	0.40	109.0	496	+	1,033	9.474
	May-Sep	Seine	0.00	6.70	32.01	38.46	7.44	11.41	2.23	0.74	0.74	0.25	106.6	403	+	346	3.243
19623	Oct-Dec	Seine	0.00	76.33	15.42	4.46	3.10	0.28	0.35	0.06	0.00	0.00	55.5	1,267		9,769	199.178
	Oct-Dec	Trawl	0.00	41.59	13.61	17.25	21.11	3.14	2.79	0.41	0.06	0.03	80.9	3,188	+	123	1.526
	Jan-Apr	Seine	0.00	38.55	15.20	21.58	17.43	3.27	3.61	0.21	0.06	0.10	96.9	1,921		29,142	350.900
	Jan-Apr	Trawl	0.00	41.59	13.61	17.25	21.11	3.14	2.79	0.41	0.06	0.03	80.9	3,188	+	457	5.653
	May-Sep	Seine	0.00	60.74	16.33	12.62	7.12	1.42	1.69	0.01	0.00	0.07	74.6	3,188	+	736	11.819
19634	Oct-Dec	Seine	0.00	2.51	71.43	11.94	7.88	5.04	0.85	0.35	0.00	0.00	84.2	1,644		14,887	170.573
	Oct-Dec	Trawl	0.00	3.26	65.07	10.15	11.10	8.98	0.69	0.60	0.12	0.03	85.8	3,341	+	44	0.519
	Jan-Apr	Seine	0.00	1.29	48.47	10.21	19.65	17.00	1.48	1.38	0.40	0.11	89.9	1,697		13,180	135.777
	Jan-Apr	Trawl	0.00	3.26	65.07	10.15	11.10	8.98	0.69	0.60	0.12	0.03	85.8	3,341	+	537	6.254
	May-Sep	Seine	0.00	2.89	67.52	11.86	10.20	6.38	0.60	0.43	0.11	0.02	80.8	3,341	+	1,282	14.960
19645	Oct-Dec	Seine	0.00	9.22	19.05	45.55	10.13	10.34	4.75	0.71	0.22	0.03	127.7	805		5,435	40.840
	Jan-Apr	Seine	0.00	4.99	13.41	53.55	9.70	9.66	7.23	1.03	0.37	0.06	118.0	2,088		12,851	99.593
	May-Sep	Seine	0.00	6.54	15.87	50.81	10.48	9.83	5.18	0.95	0.34	0.77	124.0	2,893	+	25,924	191.386
19656	Oct-Dec	Seine	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0	*	3,312	24.120
	Jan-Apr	Seine	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0	*	9,151	66.643
	Jan-Apr	Trawl	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0	*	1	0.007
	May-Sep	Seine	0.00	0.00	5.29	21.38	23.45	16.32	19.08	9.66	3.22	1.61	137.3	0	*	4,831	35.181
19667	Oct-Dec	Seine	0.00	57.22	32.31	5.37	1.88	2.70	0.41	0.20	0.00	0.00	65.7	0	*	4,379	66.650
	Jan-Apr	Seine	0.00	57.22	32.31	5.37	1.88	2.70	0.41	0.20	0.00	0.00	65.7	0	*	2,338	35.588
	May-Sep	Seine	0.00	57.22	32.31	5.37	1.88	2.70	0.41	0.20	0.00	0.00	65.7	0	*	1,280	19.484
19678	Oct-Dec	Seine	0.00	34.87	39.74	19.40	4.59	0.73	0.26	0.14	0.27	0.00	77.9	0	*	53	0.678
	Jan-Apr	Seine	0.00	34.87	39.74	19.40	4.59	0.73	0.26	0.14	0.27	0.00	77.9	0	*	1,084	13.902

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

Season	Fishery	Gear	PERCENT AT AGE 0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged		CATCH (tonnes)	(millions)	
19678	May-Sep	Seine	0.00	34.87	39.74	19.40	4.59	0.73	0.26	0.14	0.27	0.00	77.9	0	*	932	11.953	
19690	Jan-Apr	Seine	0.00	18.67	62.91	15.11	3.12	0.03	0.08	0.08	0.00	0.00	81.6	0	*	1,330	16.304	
19701	Jan-Apr	Seine	0.00	5.79	45.91	31.35	9.51	5.05	1.63	0.59	0.15	0.00	92.2	673		3,418	37.076	
	May-Sep	Seine	0.00	5.79	45.91	31.35	9.51	5.05	1.63	0.59	0.15	0.00	92.2	673	+	82	0.894	
19712	Jan-Apr	Gillnet	0.00	0.00	0.96	39.42	21.15	34.62	2.88	0.96	0.00	0.00	168.2	104	+	4	0.023	
	Jan-Apr	Seine	0.00	0.00	5.32	17.93	64.43	5.88	3.78	2.38	0.14	0.14	161.3	714		4,490	27.842	
19723	Oct-Dec	Seine	0.00	3.89	35.37	4.95	27.58	23.05	3.26	1.26	0.63	0.00	133.3	950	+	16	0.123	
	Jan-Apr	Seine	0.00	0.61	33.23	4.45	30.09	26.25	3.38	1.26	0.74	0.00	137.9	950		1,524	10.454	
	May-Sep	Seine	0.00	3.89	35.37	4.95	27.58	23.05	3.26	1.26	0.63	0.00	133.3	950	+	67	0.499	
19734	Jan-Apr	Gillnet	0.00	0.00	0.96	39.42	21.15	34.62	2.88	0.96	0.00	0.00	168.2	104	+	1,519	9.034	
	Jan-Apr	Seine	0.00	0.16	17.88	53.16	7.44	16.46	4.43	0.32	0.16	0.00	132.2	632		2,300	17.401	
19745	Jan-Apr	Gillnet	0.00	0.00	0.00	31.91	59.57	8.51	0.00	0.00	0.00	0.00	140.9	47	+	11	0.076	
	Jan-Apr	Other	0.32	1.29	9.40	21.92	42.97	11.20	9.65	2.46	0.63	0.16	131.2	3,170	+	204	1.555	
	Jan-Apr	Seine	0.20	0.35	4.42	26.83	51.39	9.06	6.31	1.26	0.18	0.00	124.1	1,704		1,691	12.357	
19756	Oct-Dec	Seine	0.00	0.00	1.60	6.86	27.66	43.89	9.26	8.46	2.29	0.00	172.2	875	+	564	3.278	
	Jan-Apr	Gillnet	0.00	0.00	0.00	15.79	57.89	22.81	3.51	0.00	0.00	0.00	154.0	57	+	276	1.793	
	Jan-Apr	Other	0.00	0.00	1.60	6.86	27.66	43.89	9.26	8.46	2.29	0.00	172.2	875	+	409	2.375	
	Jan-Apr	Seine	0.00	0.00	0.90	7.22	32.25	49.73	7.47	1.74	0.70	0.00	169.6	713		3,466	20.451	
19767	Oct-Dec	Seine	0.00	0.08	13.52	6.40	24.30	35.92	14.53	4.01	0.80	0.43	154.2	1,821	+	296	1.895	
	Jan-Apr	Gillnet	0.00	0.00	1.07	2.14	19.93	54.09	14.59	6.76	1.42	0.00	166.9	281	+	1,494	8.948	
	Jan-Apr	Other	0.00	0.16	18.12	7.08	22.73	31.85	13.84	4.45	1.32	0.44	149.8	1,821	+	682	4.552	
	Jan-Apr	Seine	0.00	0.13	21.43	3.97	20.78	34.28	14.49	3.18	1.29	0.45	151.9	1,765		6,309	41.462	
	May-Sep	Gillnet	0.00	0.00	1.07	2.14	19.93	54.09	14.59	6.76	1.42	0.00	166.9	281	+	12	0.072	
	May-Sep	Seine	0.00	0.16	18.12	7.08	22.73	31.85	13.84	4.45	1.32	0.44	149.8	1,821	+	31	0.204	
19778	Oct-Dec	Seine	0.00	1.66	7.66	32.30	17.60	16.98	13.46	6.21	2.48	1.66	151.1	483		2,263	14.977	
	Oct-Dec	Trawl	0.00	1.36	10.03	31.95	13.18	19.41	17.48	4.37	1.43	0.79	150.3	1,396	+	1,024	6.814	
	Jan-Apr	Gillnet	0.00	0.00	0.00	20.53	5.96	32.45	33.11	6.62	1.32	0.00	167.1	151	+	3,031	18.142	
	Jan-Apr	Other	0.00	1.36	10.03	31.95	13.18	19.41	17.48	4.37	1.43	0.79	150.3	1,396	+	819	5.450	
	Jan-Apr	Seine	0.00	1.35	12.58	34.86	9.09	19.63	18.84	2.66	0.67	0.32	147.2	812		2,202	14.957	
	Jan-Apr	Trawl	0.00	0.99	2.97	20.79	19.80	25.74	20.79	7.92	0.99	0.00	167.6	101		0	0.000	~
	May-Sep	Seine	0.00	1.73	12.50	38.39	9.35	18.12	15.88	2.73	0.92	0.38	147.1	1,295	+	68	0.469	
19789	Oct-Dec	Seine	0.00	1.42	9.81	10.85	25.36	19.39	17.10	8.63	4.73	2.71	152.3	777		971	6.314	
	Oct-Dec	Trawl	0.00	2.04	9.07	10.37	27.96	15.37	15.37	8.52	7.04	4.26	147.9	540		690	4.664	
	Jan-Apr	Gillnet	0.00	0.00	0.00	8.25	41.24	18.56	22.68	7.56	1.72	0.00	168.4	291	+	1,236	7.338	
	Jan-Apr	Other	0.00	2.16	13.47	11.14	28.08	14.88	16.81	7.31	3.92	2.24	150.5	2,272	+	910	6.048	
	Jan-Apr	Seine	0.00	2.91	9.88	12.21	32.17	13.57	21.32	5.81	1.74	0.39	158.5	516		1,411	8.905	
	Jan-Apr	Trawl	0.00	2.04	9.07	10.37	27.96	15.37	15.37	8.52	7.04	4.26	147.9	540		0	0.000	~
	May-Sep	Seine	0.00	2.19	14.84	11.37	28.12	14.72	17.26	6.93	2.94	1.62	151.3	1,732	+	10	0.063	
19790	Oct-Dec	Seine	0.00	1.82	62.62	6.88	6.93	7.57	5.81	5.21	2.12	1.04	108.2	1,049		460	4.238	
	Oct-Dec	Trawl	0.00	1.59	73.25	7.18	5.79	4.99	3.78	2.12	0.91	0.39	99.0	4,389	+	278	2.806	
	Jan-Apr	Gillnet	0.00	0.00	4.98	7.66	35.25	19.92	19.54	8.43	3.45	0.77	162.2	261	+	1,046	6.449	
	Jan-Apr	Other	0.00	1.59	73.25	7.18	5.79	4.99	3.78	2.12	0.91	0.39	99.0	4,389	+	910	9.190	
	Jan-Apr	Seine	0.00	1.69	85.42	4.98	2.89	2.29	1.69	0.70	0.30	0.05	90.0	2,010		1,641	18.223	
	Jan-Apr	Trawl	0.00	0.00	47.95	12.33	10.96	16.44	1.37	5.48	4.11	1.37	123.9	73		0	0.000	~
19801	Oct-Dec	Seine	0.00	1.13	7.37	53.52	10.15	10.64	8.82	4.51	2.45	1.40	124.7	3,068		733	5.870	
	Oct-Dec	Trawl	0.00	1.07	7.67	56.82	8.62	9.09	9.02	3.68	2.37	1.66	119.0	3,095		949	7.928	
	Jan-Apr	Gillnet	0.00	0.00	0.37	39.18	16.42	23.13	14.55	4.48	1.87	0.00	149.7	268	+	356	2.378	
	Jan-Apr	Other	0.01	0.96	8.75	66.19	6.94	6.27	5.79	2.63	1.42	1.03	112.3	10,887	+	728	6.484	
	Jan-Apr	Seine	0.03	0.57	10.08	82.32	3.36	1.46	1.55	0.32	0.19	0.13	98.7	3,156		1,051	10.652	
	Jan-Apr	Trawl	0.00	1.07	7.21	55.35	8.89	9.56	9.66	4.17	2.36	1.74	121.0	3,095		0	0.000	~
19812	Oct-Dec	Seine	0.00	0.83	14.25	24.70	45.73	6.01	3.80	3.07	1.13	0.49	128.5	1,143		794	6.481	
	Oct-Dec	Trawl	0.00	2.34	11.99	19.03	39.60	10.11	6.80	6.60	2.13	1.39	132.6	1,283		1,021	7.686	
	Jan-Apr	Other	0.00	1.99	14.56	15.09	51.11	7.30	4.58	3.27	1.39	0.71	119.6	3,970	+	728	6.086	
	Jan-Apr	Seine	0.00	4.57	11.84	7.15	71.51	2.93	1.41	0.35	0.23	0.00	106.5	853		170	1.593	
	Jan-Apr	Trawl	0.00	2.34	11.85	18.08	40.14	10.37	6.94	6.24	2.42	1.64	132.6	1,283		0	0.000	~
19823	Jan-Apr	Other	0.00	1.35	20.82	17.74	5.26	49.16	3.73	1.13	0.59	0.22	117.7	4,583	+	773	6.565	
	Jan-Apr	Seine	0.00	1.35	20.82	17.74	5.26	49.16	3.73	1.13	0.59	0.22	117.7	4,583		0	0.000	~
19834	Oct-Dec	Seine	0.00	1.83	34.08	15.42	15.21	10.14	19.68	3.04	0.20	0.41	97.1	493		87	0.900	
	Oct-Dec	Trawl	0.00	0.93	36.45	14.29	10.74	13.57	21.95	1.30	0.42	0.34	102.3	3,772	+	54	0.529	

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

Season	Fishery	Gear	PERCENT AT AGE 0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged	CATCH (tonnes)	CATCH (millions)
19834	Jan-Apr	Gillnet	0.00	0.00	0.99	1.98	12.87	21.39	57.43	3.37	1.19	0.79	147.7	505	1,880	12.731
	Jan-Apr	Other	0.00	0.93	36.45	14.29	10.74	13.57	21.95	1.30	0.42	0.34	102.3	3,772 +	728	7.116
	Jan-Apr	Seine	0.00	0.43	32.79	11.18	9.48	17.31	27.38	0.95	0.33	0.14	106.6	3,118	1,679	15.337
	Jan-Apr	Trawl	0.00	5.59	42.86	16.77	9.94	8.70	6.21	1.86	3.73	4.35	93.4	161	0	0.000 ~
	May-Sep	Seine	0.00	0.72	36.17	14.18	10.77	13.79	22.65	1.27	0.28	0.17	102.7	3,611 +	6	0.055
19845	Oct-Dec	Seine	0.00	17.10	8.92	20.45	30.67	12.83	4.46	4.28	0.93	0.37	86.0	538	48	0.556
	Oct-Dec	Trawl	0.00	2.31	7.95	50.46	14.58	7.09	9.74	7.41	0.27	0.17	105.8	4,752 +	83	0.787
	Jan-Apr	Gillnet	0.00	0.00	0.36	16.36	14.91	15.82	21.82	29.82	0.36	0.55	147.9	550	3,476	23.500
	Jan-Apr	Other	0.00	2.31	7.95	50.46	14.58	7.09	9.74	7.41	0.27	0.17	105.8	4,752 +	728	6.884
	Jan-Apr	Seine	0.00	0.33	7.91	50.78	11.15	6.74	12.95	9.81	0.19	0.16	108.4	4,214	3,070	27.724
	May-Sep	Seine	0.00	2.15	7.95	50.48	14.31	7.07	10.01	7.61	0.27	0.17	108.3	4,752 +	70	0.662
19856	Oct-Dec	Seine	0.00	1.77	12.72	10.13	44.29	9.00	5.23	8.78	7.96	0.11	139.2	3,554 +	130	0.937
	Oct-Dec	Trawl	0.00	12.11	11.13	9.48	27.58	16.27	9.30	5.81	5.02	3.30	137.9	1,635	47	0.343
	Jan-Apr	Gillnet	0.00	0.00	0.38	4.09	54.02	18.86	8.71	7.65	6.06	0.23	147.0	1,320	4,573	31.100
	Jan-Apr	Other	0.00	4.07	13.17	9.45	42.07	12.03	6.17	6.80	5.42	0.81	135.2	7,290 +	728	5.384
	Jan-Apr	Seine	0.00	1.75	12.79	10.09	44.41	9.10	5.23	8.69	7.83	0.11	133.1	5,655	3,823	27.523
	Jan-Apr	Trawl	0.00	12.11	11.13	9.48	27.58	16.27	9.30	5.81	5.02	3.30	137.9	1,635	0	0.000 ~
	May-Sep	Seine	0.00	1.69	13.34	9.55	46.09	10.53	5.26	7.46	5.98	0.10	137.1	5,655 +	105	0.778
19867	Oct-Dec	Seine	0.00	0.60	38.78	9.59	7.26	29.94	5.84	3.59	3.09	1.33	117.1	2,977 +	47	0.398
	Jan-Apr	Gillnet	0.00	0.00	0.50	2.67	6.37	55.23	16.65	9.37	6.07	3.14	150.4	1,855	4,071	27.067
	Jan-Apr	Other	0.00	0.87	39.44	10.15	6.77	29.47	5.82	3.42	2.82	1.24	116.1	4,828 +	728	6.271
	Jan-Apr	Seine	0.00	0.45	39.37	9.51	7.32	29.04	5.78	3.72	3.34	1.47	117.1	4,049	2,100	17.695
	May-Sep	Seine	0.00	1.06	36.99	9.81	7.06	32.66	6.01	3.21	2.31	0.89	117.1	2,977 +	52	0.448
19878	Oct-Dec	Seine	0.00	0.52	35.53	36.87	5.23	7.15	11.18	1.59	1.43	0.49	100.3	3,076 +	23	0.229
	Jan-Apr	Gillnet	0.00	0.00	0.24	4.97	4.59	20.02	48.56	13.52	5.31	2.78	157.2	710	4,340	27.459
	Jan-Apr	Other	0.00	0.44	29.53	39.13	6.47	8.58	11.56	2.16	1.68	0.46	103.2	4,592 +	728	7.056
	Jan-Apr	Seine	0.00	0.52	35.53	36.87	5.23	7.15	11.18	1.59	1.43	0.49	100.3	3,076	3,550	35.399
	Jan-Apr	Trawl	0.00	0.26	13.73	41.19	11.92	11.14	11.92	4.40	4.15	1.30	109.5	386	0	0.000 ~
	May-Sep	Seine	0.00	0.45	30.98	38.94	5.97	8.35	11.53	1.95	1.45	0.38	102.6	4,206 +	56	0.542
19889	Oct-Dec	Seine	0.00	0.21	25.24	29.11	30.29	4.94	4.83	4.40	0.64	0.32	105.0	931 +	42	0.403
	Jan-Apr	Gillnet	0.00	0.00	0.00	5.11	30.02	13.98	22.91	21.87	3.66	2.46	149.3	476	4,745	31.739
	Jan-Apr	Other	0.00	0.61	21.68	36.14	27.68	4.92	4.48	3.57	0.64	0.28	104.2	3,616 +	728	6.986
	Jan-Apr	Seine	0.00	0.70	19.15	41.92	25.84	4.00	4.19	3.39	0.46	0.36	104.1	2,893	3,686	35.672
19890	Jan-Apr	Gillnet	0.00	0.00	0.00	6.25	21.32	42.46	10.29	11.58	6.07	2.02	146.7	544	2,361	16.100
	Jan-Apr	Other	0.00	0.65	18.15	22.55	28.24	20.52	4.01	3.31	2.15	0.41	119.7	5,068 +	728	6.080
	Jan-Apr	Seine	0.00	0.63	20.05	21.02	29.59	18.95	3.90	3.41	2.08	0.37	120.7	4,215	2,295	19.231
	May-Sep	Seine	0.00	0.14	14.00	25.59	26.19	24.51	3.85	3.58	1.99	0.14	120.9	5,068 +	32	0.263
19901	Jan-Apr	Gillnet	0.00	0.00	0.00	4.26	18.67	31.44	31.33	6.66	4.37	3.28	144.5	916	2,143	14.832
	Jan-Apr	Other	0.00	1.28	47.62	9.41	12.81	15.57	9.43	1.62	0.90	1.35	102.1	4,208 +	819	8.020
	Jan-Apr	Seine	0.00	1.07	51.92	9.89	11.11	15.82	7.04	1.23	0.91	1.03	98.8	2,529	1,348	13.642
	Jan-Apr	Trawl	0.00	17.05	28.41	5.68	22.73	6.82	6.82	0.00	2.27	10.23	110.2	88	0	0.000 ~
	May-Sep	Seine	0.00	0.55	40.80	10.75	16.94	17.49	11.29	1.82	0.00	0.36	108.1	549 +	19	0.172
19912	Jan-Apr	Gillnet	0.00	0.00	0.32	13.21	9.13	23.52	25.35	19.66	3.97	4.83	145.5	931	3,797	26.100
	Jan-Apr	Other	0.00	1.07	38.90	36.36	6.05	6.05	6.71	3.49	0.64	0.73	96.9	4,499 +	819	8.456
	Jan-Apr	Seine	0.00	0.19	45.84	29.44	6.36	5.42	7.73	3.60	0.74	0.67	96.6	4,265	1,377	14.161
	Jan-Apr	Trawl	0.00	14.10	21.79	20.94	8.97	18.80	6.41	4.70	1.28	2.99	108.5	234	0	0.000 ~
	May-Sep	Seine	0.00	0.70	24.97	53.31	5.57	5.34	5.23	3.95	0.46	0.46	96.2	861 +	3	0.027
19923	Jan-Apr	Gillnet	0.00	0.00	0.00	8.32	40.54	9.53	18.52	13.29	8.19	1.61	134.1	745	4,112	30.661
	Jan-Apr	Other	0.00	0.40	11.64	43.72	29.86	3.97	4.37	4.21	1.50	0.33	103.6	4,209 +	819	7.906
	Jan-Apr	Seine	0.00	0.04	6.28	56.22	21.93	4.18	4.46	4.86	1.59	0.44	103.4	3,262	2,204	20.895
	Jan-Apr	Trawl	0.00	6.59	31.87	31.32	22.53	2.75	3.85	1.10	0.00	0.00	91.4	182	0	0.000 ~
	May-Sep	Seine	0.00	0.40	21.17	25.83	39.41	4.26	3.73	3.20	1.73	0.27	101.3	751 +	5	0.046
19934	Jan-Apr	Gillnet	0.00	0.00	0.00	3.15	18.85	48.99	11.78	11.14	4.86	1.24	132.6	899	2,324	17.614
	Jan-Apr	Other	0.00	0.75	4.89	13.73	48.57	22.32	4.11	3.67	1.43	0.53	107.6	6,837 +	920	8.550
	Jan-Apr	Seine	0.00	0.47	3.34	10.44	54.82	20.19	4.55	4.05	1.50	0.64	108.9	6,643	2,364	21.475
	Jan-Apr	Trawl	0.00	3.61	4.64	27.84	38.66	20.10	2.58	1.55	1.03	0.00	106.1	194	0	0.000 ~
19945	Jan-Apr	Gillnet	0.00	0.00	0.12	1.18	16.98	34.79	39.39	4.13	1.89	1.53	131.4	848	1,355	10.311
	Jan-Apr	Other	0.07	3.18	15.31	6.76	11.26	43.18	15.74	2.43	1.27	0.80	111.4	4,396 +	1,183	10.622
	Jan-Apr	Seine	0.08	3.82	12.91	5.38	9.57	49.66	13.84	2.46	1.44	0.82	113.1	3,532	706	6.242

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.2. Age composition and catch by season, fishery and gear type for the Prince Rupert District stock assessment region. These data are used for the age-structured model analysis.

Season	Fishery	Gear	PERCENT AT AGE										Mean Weight	Number Aged		CATCH (tonnes)	CATCH (millions)	
			0+	1+	2+	3+	4+	5+	6+	7+	8+	9++						
19956	Jan-Apr	Gillnet	0.00	0.00	0.78	4.11	5.68	25.83	32.68	26.42	3.13	1.37	133.8	511		3,086	23.053	
	Jan-Apr	Other	0.00	1.08	65.37	8.94	2.82	4.26	11.72	5.19	0.37	0.26	89.0	2,697	+	1,092	12.264	
	Jan-Apr	Seine	0.00	1.08	65.37	8.94	2.82	4.26	11.72	5.19	0.37	0.26	89.0	2,697		0	0.000	~
19967	Jan-Apr	Gillnet	0.00	0.00	0.16	19.49	11.57	13.95	20.29	20.60	11.09	2.85	133.4	631		5,541	41.550	
	Jan-Apr	Other	0.00	1.30	22.79	53.63	8.01	2.52	4.93	4.74	1.85	0.22	88.5	2,698	+	942	10.642	
	Jan-Apr	Seine	0.00	1.30	22.79	53.63	8.01	2.52	4.93	4.74	1.85	0.22	88.5	2,698		0	0.000	~
19978	Jan-Apr	Gillnet	0.00	0.00	0.65	3.05	43.07	20.52	9.89	11.28	7.02	4.53	127.9	1,082		3,217	25.158	
	Jan-Apr	Other	0.00	0.19	33.18	21.98	36.29	4.44	1.42	1.09	1.28	0.14	83.2	2,116	+	910	10.943	
	Jan-Apr	Seine	0.00	0.19	33.18	21.98	36.29	4.44	1.42	1.09	1.28	0.14	83.2	2,116		0	0.000	~
19989	Oct-Dec	Gillnet	0.00	0.00	0.00	10.82	16.50	49.51	13.45	4.58	1.94	3.19	125.8	721	+	1	0.007	
	Jan-Apr	Gillnet	0.00	0.00	0.00	11.18	16.22	48.98	13.23	4.72	2.20	3.46	126.1	721		1,858	14.716	
	Jan-Apr	Other	0.00	0.99	5.52	41.05	20.35	24.71	4.42	1.05	0.87	1.05	103.4	1,720	+	1,001	9.684	
	Jan-Apr	Seine	0.00	0.93	3.39	51.17	20.68	17.76	2.92	0.47	1.17	1.52	105.5	856		511	4.849	
19990	Jan-Apr	Gillnet	0.00	0.00	0.12	2.10	23.06	20.47	42.17	9.37	1.11	1.60	133.7	811		3,030	22.657	
	Jan-Apr	Other	0.00	1.94	27.97	9.59	28.50	12.54	16.26	2.24	0.50	0.45	95.5	3,972	+	1,001	10.482	
	Jan-Apr	Seine	0.00	1.73	24.93	8.36	35.72	14.21	12.13	2.01	0.41	0.49	95.8	3,972		1,404	13.925	
20001	Jan-Apr	Gillnet	0.00	0.00	0.29	5.58	9.33	32.40	20.67	25.58	5.29	0.87	134.3	1,040		3,811	28.369	
	Jan-Apr	Other	0.00	1.81	42.75	20.99	5.42	15.40	6.71	5.92	0.89	0.12	89.8	5,188	+	1,001	11.146	
	Jan-Apr	Seine	0.00	0.53	28.84	25.30	5.65	23.85	9.15	5.34	1.14	0.22	103.9	2,285		1,012	9.743	
20012	Oct-Dec	Seine	0.00	6.46	19.96	33.93	19.48	4.40	9.90	3.82	1.76	0.29	91.5	2,726	+	1	0.009	
	Jan-Apr	Gillnet	0.00	0.00	0.11	7.05	20.25	11.72	27.42	15.81	15.36	2.28	143.2	879		2,432	16.982	
	Jan-Apr	Other	0.00	6.46	19.96	33.93	19.48	4.40	9.90	3.82	1.76	0.29	91.5	2,726	+	910	9.947	
	Jan-Apr	Seine	0.00	7.62	19.15	32.09	20.83	4.17	10.33	3.99	1.51	0.31	92.4	2,256		2,061	22.315	

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.3. Age composition and catch by season, fishery and gear type for the Central Coast stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19501	Oct-Dec	Seine	0.00	2.68	28.09	50.52	12.28	5.17	1.20	0.06	0.00	0.00	109.2	3,175		15,508	141.986
	Jan-Apr	Seine	0.06	2.25	31.20	49.36	11.23	4.84	1.06	0.01	0.00	0.00	107.9	2,143		26,950	250.936
19512	Jan-Apr	Seine	0.25	4.61	20.10	29.98	38.50	4.56	1.55	0.40	0.04	0.02	112.7	5,214		33,072	290.690
	May-Sep	Seine	1.11	5.12	19.85	29.75	37.71	4.45	1.52	0.44	0.04	0.02	112.3	5,214	+	123	1.091
19523	Jan-Apr	Seine	0.43	7.65	28.02	24.49	27.28	10.25	1.40	0.48	0.00	0.00	104.9	2,939		768	7.304
19534	Oct-Dec	Seine	0.15	7.31	69.86	17.41	3.99	1.06	0.15	0.00	0.08	0.00	63.6	1,327		6,389	100.473
	Jan-Apr	Seine	0.00	1.72	72.02	21.04	3.91	1.10	0.15	0.00	0.06	0.00	76.2	1,739		18,119	243.703
	May-Sep	Seine	0.07	4.04	69.18	20.52	4.63	1.34	0.16	0.00	0.07	0.00	71.1	3,066	+	109	1.531
19545	Oct-Dec	Seine	0.29	9.94	6.32	77.40	5.10	0.48	0.48	0.00	0.00	0.00	85.4	826		2,559	28.033
	Jan-Apr	Seine	0.00	1.31	5.42	80.39	11.08	1.56	0.25	0.00	0.00	0.00	99.8	1,524		9,035	90.856
19556	Oct-Dec	Seine	0.10	13.79	13.63	11.05	58.24	2.85	0.25	0.10	0.00	0.00	91.4	2,408		22,335	208.767
	Jan-Apr	Seine	0.00	7.39	12.21	8.70	67.86	3.36	0.43	0.00	0.00	0.04	114.2	2,614		21,018	178.311
	May-Sep	Seine	0.04	16.97	13.60	9.12	56.99	2.89	0.34	0.04	0.00	0.02	105.4	5,022	+	275	2.606
19567	Oct-Dec	Seine	0.00	52.32	42.90	3.83	0.55	0.27	0.14	0.00	0.00	0.00	60.1	732		1,788	29.756
	Jan-Apr	Seine	0.00	3.59	52.30	13.98	8.33	20.79	0.98	0.03	0.00	0.00	93.9	3,890		21,002	211.756
	May-Sep	Seine	0.00	23.13	49.84	9.53	5.03	11.85	0.59	0.02	0.00	0.00	79.6	4,622	+	470	5.669
19578	Oct-Dec	Seine	0.00	40.38	49.69	8.01	1.33	0.17	0.42	0.00	0.00	0.00	61.5	2,106		4,928	79.258
	Jan-Apr	Seine	0.00	5.67	73.61	17.35	1.50	1.22	0.65	0.00	0.00	0.00	73.8	1,472		4,454	60.180
	May-Sep	Seine	0.00	47.57	42.11	7.27	2.01	0.42	0.62	0.00	0.00	0.00	64.8	3,578	+	467	8.141
19589	Oct-Dec	Seine	0.17	5.25	49.47	35.94	7.43	0.61	0.57	0.55	0.01	0.00	83.4	2,169		10,774	125.789
	Jan-Apr	Seine	0.00	0.74	47.39	40.66	9.62	0.72	0.52	0.35	0.00	0.00	88.2	2,594		17,096	192.788
19590	Oct-Dec	Seine	0.00	42.87	24.11	26.16	5.59	1.10	0.08	0.08	0.00	0.00	62.1	1,269		3,397	54.675
	Jan-Apr	Seine	0.00	41.51	23.53	27.72	5.86	1.22	0.08	0.08	0.00	0.00	63.7	1,313	+	640	10.054
19601	Oct-Dec	Seine	0.00	64.30	28.81	3.34	2.30	1.25	0.00	0.00	0.00	0.00	51.4	479		956	18.581
	Jan-Apr	Seine	0.00	4.30	32.64	12.80	36.63	12.48	0.94	0.16	0.05	0.00	100.6	2,302		30,641	302.709
	May-Sep	Seine	0.00	16.18	32.43	10.82	29.70	9.92	0.79	0.11	0.04	0.00	91.1	2,781	+	104	1.136
	May-Sep	Trawl	0.00	16.18	32.43	10.82	29.70	9.92	0.79	0.11	0.04	0.00	91.1	2,781	+	4	0.042
19612	Oct-Dec	Seine	0.00	7.65	54.80	20.82	2.85	11.39	2.31	0.18	0.00	0.00	94.1	562	+	677	7.197
	Jan-Apr	Seine	0.00	3.73	51.28	25.17	2.80	13.99	2.80	0.23	0.00	0.00	99.6	429		14,942	150.045
	May-Sep	Seine	0.00	7.65	54.80	20.82	2.85	11.39	2.31	0.18	0.00	0.00	94.1	562	+	90	0.954
19623	Oct-Dec	Seine	0.00	0.36	30.27	58.03	5.25	2.86	3.02	0.21	0.00	0.00	100.6	1,052	+	124	1.232
	Jan-Apr	Seine	0.00	0.35	30.14	58.19	5.18	2.86	3.07	0.21	0.00	0.00	100.6	1,052		43,930	436.570
19634	Oct-Dec	Seine	0.00	14.03	46.96	27.37	10.09	1.45	0.09	0.00	0.00	0.00	91.1	1,169	+	3,214	35.288
	Jan-Apr	Seine	0.00	4.88	43.06	35.48	14.65	1.80	0.13	0.00	0.00	0.00	103.4	778		28,288	273.620
	Jan-Apr	Trawl	0.00	14.03	46.96	27.37	10.09	1.45	0.09	0.00	0.00	0.00	91.1	1,169	+	228	2.507
	May-Sep	Seine	0.00	14.03	46.96	27.37	10.09	1.45	0.09	0.00	0.00	0.00	91.1	1,169	+	165	1.808
19645	Oct-Dec	Seine	0.00	14.07	37.58	31.01	12.10	5.03	0.18	0.03	0.00	0.00	114.4	1,750	+	1,562	14.266
	Jan-Apr	Seine	0.00	3.62	35.16	37.44	17.59	5.77	0.39	0.03	0.00	0.00	122.3	1,652		12,630	101.310
	May-Sep	Seine	0.00	8.49	36.46	33.62	15.63	5.41	0.33	0.06	0.00	0.00	111.9	1,750	+	1,477	12.553
19656	Oct-Dec	Seine	0.00	67.32	20.43	7.33	3.60	1.13	0.19	0.00	0.00	0.00	71.9	0	*	16,217	225.703
	Jan-Apr	Seine	0.00	67.32	20.43	7.33	3.60	1.13	0.19	0.00	0.00	0.00	71.9	0	*	19,101	265.835
	May-Sep	Seine	0.00	67.32	20.43	7.33	3.60	1.13	0.19	0.00	0.00	0.00	71.9	0	*	2,163	30.107
19667	Oct-Dec	Seine	0.00	37.40	46.19	13.10	2.04	1.02	0.17	0.07	0.01	0.00	87.0	0	*	2,910	33.432
	Jan-Apr	Seine	0.00	37.40	46.19	13.10	2.04	1.02	0.17	0.07	0.01	0.00	87.0	0	*	17,206	197.668
	May-Sep	Seine	0.00	37.40	46.19	13.10	2.04	1.02	0.17	0.07	0.01	0.00	87.0	0	*	1,774	20.378
19678	Oct-Dec	Seine	0.00	32.53	48.02	17.02	2.11	0.25	0.00	0.06	0.00	0.00	89.8	0	*	497	5.535
	Jan-Apr	Seine	0.00	32.53	48.02	17.02	2.11	0.25	0.00	0.06	0.00	0.00	89.8	0	*	309	3.439
	May-Sep	Seine	0.00	32.53	48.02	17.02	2.11	0.25	0.00	0.06	0.00	0.00	89.8	0	*	722	8.043
19690	Jan-Apr	Seine	0.00	54.02	44.42	1.16	0.40	0.00	0.00	0.00	0.00	0.00	73.9	0	*	209	2.832
19701	Jan-Apr	Seine	0.06	12.04	39.34	39.20	4.11	4.33	0.72	0.06	0.13	0.00	108.2	953		3,614	32.684
19712	Jan-Apr	Gillnet	0.00	0.00	2.27	18.18	61.36	11.36	6.82	0.00	0.00	0.00	159.6	44	+	137	0.855
	Jan-Apr	Seine	0.00	3.54	28.25	27.13	27.01	7.57	5.17	1.26	0.08	0.00	120.5	1,763		9,143	74.425
19723	Jan-Apr	Gillnet	0.00	0.00	4.04	28.28	43.43	21.21	2.02	1.01	0.00	0.00	152.8	99	+	1,113	7.288
	Jan-Apr	Seine	0.00	0.97	48.51	18.90	16.23	12.72	2.02	0.47	0.19	0.00	125.2	1,239		6,664	52.842
	May-Sep	Seine	0.00	1.21	49.64	18.40	15.98	12.11	2.02	0.48	0.16	0.00	124.7	1,239	+	22	0.178
19734	Jan-Apr	Gillnet	0.00	0.00	0.42	22.36	38.82	24.47	12.24	1.69	0.00	0.00	158.5	474		5,267	33.230
	Jan-Apr	Seine	0.00	2.94	20.26	42.18	18.05	10.26	5.42	0.71	0.18	0.00	129.5	1,515		3,621	28.835
19745	Jan-Apr	Gillnet	0.00	0.00	4.27	26.40	45.60	15.73	5.60	2.40	0.00	0.00	152.8	375	+	5,395	35.308
	Jan-Apr	Seine	0.18	0.99	48.84	22.87	19.00	5.33	2.25	0.48	0.04	0.02	119.5	8,923		3,343	31.457

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.3. Age composition and catch by season, fishery and gear type for the Central Coast stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19756	Jan-Apr	Gillnet	0.00	0.00	0.86	18.72	30.18	35.12	11.56	3.02	0.44	0.09	162.0	1,222		6,213	38.357
	Jan-Apr	Seine	0.00	2.18	11.33	41.86	21.86	16.69	4.31	1.52	0.24	0.02	124.4	5,418		6,198	50.662
19767	Jan-Apr	Gillnet	0.00	0.00	1.10	13.02	35.54	31.57	13.47	3.97	1.32	0.00	167.7	453		6,904	41.171
	Jan-Apr	Seine	0.00	0.70	17.01	23.32	31.11	17.06	8.70	1.72	0.34	0.05	136.6	2,606		4,201	30.702
19778	Jan-Apr	Gillnet	0.00	0.00	0.83	8.45	32.10	38.26	16.57	3.21	0.44	0.15	162.1	886		9,277	56.466
	Jan-Apr	Other	0.00	0.22	25.59	15.24	19.99	23.15	10.86	3.52	1.08	0.36	134.7	1,391	+	182	1.352
	Jan-Apr	Seine	0.00	0.19	28.64	16.47	21.54	21.13	8.68	2.56	0.59	0.20	129.6	1,391		4,723	37.629
	May-Sep	Seine	0.00	0.18	29.21	16.70	21.83	20.76	8.28	2.38	0.50	0.17	124.6	1,391	+	46	0.369
19789	Oct-Dec	Seine	0.00	5.70	4.40	31.50	18.70	21.30	15.10	2.80	0.40	0.10	151.8	0	*	0	0.001
	Jan-Apr	Other	0.00	5.70	4.40	31.50	18.70	21.30	15.10	2.80	0.40	0.10	151.8	0	*	91	0.600
	May-Sep	Seine	0.00	5.70	4.40	31.50	18.70	21.30	15.10	2.80	0.40	0.10	151.8	0	*	5	0.031
19790	Oct-Dec	Seine	0.06	5.59	69.33	6.94	9.48	4.51	2.87	0.72	0.42	0.09	91.4	3,345	+	10	0.111
	Jan-Apr	Gillnet	0.00	0.00	5.36	0.89	34.82	21.43	18.75	11.61	6.25	0.89	157.9	112	+	528	3.347
	Jan-Apr	Other	0.06	5.59	69.33	6.94	9.48	4.51	2.87	0.72	0.42	0.09	91.4	3,345	+	91	0.995
	Jan-Apr	Seine	0.06	5.59	69.33	6.94	9.48	4.51	2.87	0.72	0.42	0.09	91.4	3,345		0	0.000 ~
19801	Jan-Apr	Gillnet	0.00	0.28	1.47	47.46	12.43	15.35	12.78	6.94	2.48	0.82	142.5	1,418		2,304	15.892
	Jan-Apr	Other	0.00	3.78	14.57	63.82	7.83	6.03	2.80	0.67	0.36	0.13	99.2	5,210	+	91	0.917
	Jan-Apr	Seine	0.00	1.88	14.92	68.45	7.06	4.98	1.95	0.44	0.29	0.04	101.3	5,210		263	2.570
	May-Sep	Seine	0.00	3.78	14.57	63.82	7.83	6.03	2.80	0.67	0.36	0.13	99.2	5,210	+	6	0.063
19812	Jan-Apr	Gillnet	0.00	0.00	2.88	6.96	76.07	7.38	5.17	1.20	0.33	0.01	141.3	1,242		4,112	29.155
	Jan-Apr	Other	0.00	1.68	15.62	10.72	60.21	5.19	4.56	1.45	0.48	0.09	122.2	3,508	+	91	0.745
	Jan-Apr	Seine	0.00	0.61	11.52	10.17	66.35	5.52	4.26	1.26	0.30	0.00	131.9	2,300		2,258	17.116
	May-Sep	Seine	0.00	0.61	11.52	10.17	66.35	5.52	4.26	1.26	0.30	0.00	131.9	2,300	+	0	0.003
19823	Jan-Apr	Gillnet	0.00	0.00	0.56	7.56	13.82	68.06	5.22	3.93	0.62	0.23	146.7	1,703		3,579	24.422
	Jan-Apr	Other	0.00	0.53	7.00	15.43	10.82	57.10	5.03	3.10	0.73	0.26	133.2	5,445	+	273	2.050
	Jan-Apr	Seine	0.00	0.58	7.06	13.65	11.15	58.16	5.32	3.13	0.64	0.31	134.7	5,445		2,061	15.154
19834	Jan-Apr	Gillnet	0.00	0.00	0.27	2.69	12.49	16.84	61.49	4.63	1.07	0.53	145.1	1,092		3,582	24.536
	Jan-Apr	Other	0.02	4.35	7.31	10.12	18.16	16.14	40.72	2.26	0.83	0.10	127.1	6,294	+	273	2.148
	Jan-Apr	Seine	0.00	2.29	5.47	7.67	17.73	17.04	47.03	1.93	0.69	0.14	128.0	6,294		3,589	28.383
19845	Jan-Apr	Gillnet	0.00	0.00	3.78	6.27	9.37	20.63	23.57	35.09	0.85	0.44	161.3	1,507		2,294	14.082
	Jan-Apr	Other	0.00	2.75	37.85	7.56	8.43	12.87	11.77	18.20	0.44	0.13	130.2	5,422	+	273	2.097
	Jan-Apr	Seine	0.00	0.61	28.72	8.11	9.89	17.28	14.48	20.15	0.49	0.26	136.5	3,690		2,915	20.337
19856	Oct-Dec	Seine	0.00	4.00	16.21	39.67	8.61	6.41	6.74	6.12	11.63	0.62	135.0	5,995	+	30	0.224
	Jan-Apr	Gillnet	0.00	0.00	2.01	21.83	14.45	7.98	14.53	14.47	24.18	0.56	155.5	1,020		1,176	7.676
	Jan-Apr	Other	0.00	4.00	16.21	39.67	8.61	6.41	6.74	6.12	11.63	0.62	135.0	5,995	+	214	1.585
	Jan-Apr	Seine	0.00	0.94	14.64	41.12	10.95	5.12	6.40	6.55	13.85	0.43	138.7	3,983		2,173	16.047
	Jan-Apr	Trawl	0.00	4.00	16.21	39.67	8.61	6.41	6.74	6.12	11.63	0.62	135.0	5,995	+	7	0.054
19867	Jan-Apr	Gillnet	0.00	0.00	0.82	7.75	44.85	11.72	7.85	9.89	8.15	8.97	165.2	981		920	5.571
	Jan-Apr	Other	0.00	4.99	22.77	14.49	31.67	5.63	4.48	5.73	4.58	5.67	137.6	5,134	+	214	1.555
	Jan-Apr	Seine	0.00	4.13	20.03	13.26	32.77	5.60	5.06	6.71	5.11	7.33	143.9	3,614		2,695	18.225
19878	Jan-Apr	Gillnet	0.00	0.00	4.39	10.69	15.27	27.48	13.74	7.06	9.73	11.64	162.2	524		970	5.978
	Jan-Apr	Other	0.00	1.14	67.92	11.67	6.28	7.12	1.68	1.46	1.50	1.23	103.4	5,194	+	273	2.639
	Jan-Apr	Seine	0.00	0.82	65.84	12.35	6.16	8.30	1.73	1.71	1.68	1.40	107.5	4,159		3,539	31.909
	May-Sep	Seine	0.00	0.81	65.96	12.42	6.14	8.29	1.66	1.73	1.66	1.34	110.9	2,835	+	18	0.162
19889	Jan-Apr	Gillnet	0.00	0.00	0.32	29.13	25.73	17.31	14.72	5.34	3.72	3.72	147.9	618		2,911	19.680
	Jan-Apr	Other	0.00	1.28	4.61	76.21	9.16	3.58	2.80	0.74	0.80	0.82	109.5	5,642	+	273	2.492
	Jan-Apr	Seine	0.00	0.84	3.72	79.59	8.59	2.79	2.28	0.60	0.87	0.71	112.1	4,321		6,531	61.253
19890	Jan-Apr	Gillnet	0.00	0.00	0.00	1.03	68.15	16.46	5.46	6.48	1.10	1.32	144.7	806		3,046	20.978
	Jan-Apr	Other	0.00	0.96	5.60	5.06	72.67	7.47	3.77	2.95	0.75	0.77	127.9	6,843	+	273	2.134
	Jan-Apr	Seine	0.00	0.81	3.55	5.07	74.01	7.47	3.93	3.48	0.81	0.85	131.1	6,843		5,305	39.561
19901	Jan-Apr	Gillnet	0.00	0.00	0.56	2.41	6.30	69.81	9.44	7.04	3.52	0.93	154.7	540		1,806	11.673
	Jan-Apr	Other	0.03	2.03	18.81	6.75	6.19	55.54	6.37	2.34	1.48	0.46	131.0	7,107	+	455	3.474
	Jan-Apr	Seine	0.00	1.76	16.48	7.41	6.52	56.72	6.70	2.34	1.70	0.36	133.9	7,107		7,097	52.412
19912	Jan-Apr	Gillnet	0.00	0.00	6.87	6.96	4.42	6.98	60.93	9.67	2.99	1.19	155.5	1,119		1,111	6.991
	Jan-Apr	Other	0.00	2.01	58.38	11.40	2.74	3.44	18.75	2.13	0.61	0.54	105.4	7,264	+	455	4.315
	Jan-Apr	Seine	0.00	0.94	60.91	10.17	2.47	2.95	19.02	2.03	0.79	0.72	107.2	7,264		7,251	66.620
19923	Jan-Apr	Gillnet	0.00	0.00	0.20	45.74	14.12	5.43	5.88	25.47	2.48	0.67	138.9	781		2,038	14.682
	Jan-Apr	Other	0.00	2.88	6.70	64.08	9.69	2.02	2.57	10.47	1.12	0.47	111.4	8,751	+	455	4.084
	Jan-Apr	Seine	0.00	3.37	7.06	63.75	9.66	1.85	2.41	10.22	1.24	0.43	112.3	6,939		8,478	75.838

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.3. Age composition and catch by season, fishery and gear type for the Central Coast stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE									Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19934	Jan-Apr	Gillnet	0.00	0.00	1.73	5.09	66.34	12.30	3.27	4.00	6.51	0.77	133.8	1,951		2,122	15.809
	Jan-Apr	Other	0.00	1.16	21.05	8.48	53.20	7.51	2.03	2.72	3.52	0.33	115.9	7,308	+	455	3.925
	Jan-Apr	Seine	0.00	0.87	18.91	7.17	56.09	7.93	2.09	3.02	3.51	0.42	118.7	6,174		9,757	81.704
19945	Jan-Apr	Gillnet	0.00	0.00	0.23	8.93	8.00	64.84	10.67	1.79	2.23	3.31	137.4	1,267		1,451	10.565
	Jan-Apr	Other	0.00	0.77	6.06	23.46	9.32	48.00	6.35	2.00	2.29	1.75	124.8	9,592	+	637	5.105
	Jan-Apr	Seine	0.00	0.58	5.12	22.95	9.25	49.46	6.30	2.18	2.34	1.81	127.0	8,932		8,131	64.167
19956	Jan-Apr	Gillnet	0.00	0.00	0.39	1.55	18.33	11.88	53.07	10.48	1.97	2.33	146.4	566		402	2.743
	Jan-Apr	Other	0.00	11.91	19.89	5.77	16.53	6.93	30.32	5.80	1.48	1.37	117.8	5,601	+	1,001	8.494
	Jan-Apr	Seine	0.00	12.82	18.28	5.03	16.68	7.26	31.17	5.89	1.57	1.31	124.2	4,087		3,897	32.478
19967	Jan-Apr	Gillnet	0.00	0.00	1.36	2.92	6.23	22.76	19.26	38.33	7.20	1.95	143.5	514		344	2.401
	Jan-Apr	Other	0.00	2.13	56.65	16.89	3.62	6.14	3.99	8.49	1.54	0.55	92.7	6,870	+	1,183	12.756
	Jan-Apr	Seine	0.00	2.20	56.77	15.70	3.46	6.65	4.27	8.66	1.70	0.58	94.3	5,235		3,276	34.713
19978	Jan-Apr	Gillnet	0.00	0.00	0.44	13.09	12.55	8.50	18.31	16.51	22.13	8.46	140.4	1,031		639	4.483
	Jan-Apr	Other	0.00	0.52	36.42	42.50	8.42	2.36	3.07	3.01	2.92	0.78	89.2	6,571	+	1,183	13.268
	Jan-Apr	Seine	0.00	0.52	30.62	41.30	7.99	2.46	6.42	5.30	4.48	0.90	97.1	1,339		7,963	81.986
19989	Jan-Apr	Gillnet	0.00	0.00	0.13	15.27	45.02	17.80	6.24	5.31	5.44	4.78	128.8	753		1,524	11.833
	Jan-Apr	Other	0.00	0.78	8.79	42.78	34.15	6.51	1.62	2.12	1.94	1.32	98.7	5,005	+	1,092	11.063
	Jan-Apr	Seine	0.00	0.39	8.47	40.02	34.44	7.61	2.15	2.79	2.60	1.53	99.8	5,005		6,449	63.286
19990	Jan-Apr	Gillnet	0.00	0.00	0.44	2.04	40.44	41.61	10.36	1.61	0.88	2.63	133.0	685		1,077	8.093
	Jan-Apr	Other	0.00	0.35	19.11	10.82	34.72	26.20	5.81	1.17	0.91	0.91	109.6	4,527	+	1,274	11.625
	Jan-Apr	Seine	0.00	0.20	17.26	10.45	33.08	28.77	6.39	1.44	1.16	1.25	110.1	4,527		6,803	58.874
20001	Jan-Apr	Gillnet	0.00	0.00	0.00	4.87	5.75	52.75	28.13	7.12	1.13	0.25	135.3	800		517	3.822
	Jan-Apr	Other	0.02	2.54	7.70	27.04	11.71	26.57	18.82	4.10	0.86	0.63	112.9	4,415	+	889	7.875
	Jan-Apr	Seine	0.01	2.11	7.09	24.84	12.46	25.26	21.37	5.12	1.18	0.57	117.5	3,070		5,950	49.818
20012	Jan-Apr	Gillnet	0.00	0.00	0.60	5.95	20.83	7.54	47.02	16.47	1.39	0.20	128.6	504		399	3.099
	Jan-Apr	Other	0.00	3.33	29.74	10.27	18.04	6.20	21.57	8.96	1.54	0.34	100.5	3,514	+	980	9.755
	Jan-Apr	Seine	0.00	3.58	28.09	10.21	15.81	7.41	22.91	9.65	1.91	0.43	102.1	1,734		2,894	27.619

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19501	Oct-Dec	Seine	0.03	4.32	58.19	28.93	6.71	1.40	0.30	0.10	0.02	0.00	99.6	7,816	42,180	424.795
	Jan-Apr	Seine	0.06	4.40	32.64	48.59	10.65	2.76	0.62	0.23	0.06	0.00	103.6	1,774 +	1,226	11.828
	May-Sep	Seine	0.04	3.46	61.00	26.57	7.12	1.25	0.43	0.12	0.00	0.00	99.5	7,816 +	393	3.923
19512	Oct-Dec	Seine	0.11	14.85	55.11	21.73	6.50	1.32	0.28	0.08	0.01	0.00	93.0	8,839	44,896	492.871
	Jan-Apr	Seine	0.16	21.32	49.53	21.11	6.19	1.52	0.11	0.05	0.00	0.00	91.8	8,839 +	423	4.847
	Jan-Apr	Trawl	0.00	0.00	50.26	36.79	9.84	2.59	0.52	0.00	0.00	0.00	115.6	193	0	0.000 ~
	May-Sep	Seine	0.03	5.73	55.51	29.95	7.19	1.34	0.20	0.05	0.00	0.00	97.0	8,839 +	527	5.222
19523	Oct-Dec	Seine	0.10	1.72	54.76	38.77	3.97	0.52	0.07	0.10	0.00	0.00	87.1	3,810	3,750	41.452
	Oct-Dec	Trawl	0.00	1.58	63.29	30.79	3.68	0.66	0.00	0.00	0.00	0.00	88.4	760	29	0.326
	Jan-Apr	Seine	0.14	3.79	65.35	27.05	2.97	0.62	0.07	0.00	0.00	0.00	81.0	5,220	3,966	48.795
	Jan-Apr	Trawl	0.00	5.91	67.27	23.62	2.60	0.60	0.00	0.00	0.00	0.00	78.0	999	225	2.888
	May-Sep	Seine	0.17	2.60	55.66	37.08	3.71	0.63	0.09	0.07	0.00	0.00	84.6	9,030 +	442	5.059
19534	Oct-Dec	Seine	0.00	1.12	53.97	36.36	6.83	1.38	0.27	0.06	0.01	0.00	96.0	9,693	57,443	595.913
	Jan-Apr	Seine	0.00	2.17	43.19	41.52	8.91	3.32	0.70	0.18	0.01	0.00	94.5	3,618 +	619	6.600
	Jan-Apr	Trawl	0.00	1.36	52.67	36.83	7.07	1.66	0.33	0.08	0.01	0.00	95.7	9,788 +	14	0.142
	May-Sep	Seine	0.00	1.78	22.05	37.29	26.45	8.79	2.98	0.60	0.07	0.00	119.9	3,374	7,692	62.447
19545	Oct-Dec	Seine	0.00	3.92	56.38	33.92	5.18	0.52	0.09	0.00	0.00	0.00	98.5	4,028	50,604	503.361
	Oct-Dec	Trawl	0.00	4.65	50.12	38.35	5.99	0.80	0.10	0.00	0.00	0.00	95.8	4,994 +	5	0.054
	Jan-Apr	Seine	0.00	3.50	22.26	60.88	11.00	2.22	0.15	0.00	0.00	0.00	85.6	896	13,825	161.566
	Jan-Apr	Trawl	0.00	8.57	57.14	25.71	8.57	0.00	0.00	0.00	0.00	0.00	84.7	70	0	0.000 ~
	May-Sep	Seine	0.00	4.65	49.87	38.62	5.95	0.82	0.10	0.00	0.00	0.00	94.5	4,924 +	4,207	43.919
19556	Oct-Dec	Seine	0.00	4.07	52.03	30.65	11.30	1.65	0.29	0.00	0.00	0.00	97.4	3,783	44,043	451.810
	Oct-Dec	Trawl	0.00	5.52	58.00	26.95	8.19	1.05	0.29	0.00	0.00	0.00	93.7	1,050	182	1.944
	Jan-Apr	Seine	0.00	4.10	14.20	29.99	41.94	7.87	1.37	0.43	0.09	0.02	109.1	4,816	26,375	243.982
	Jan-Apr	Trawl	0.00	18.62	44.38	24.62	10.24	1.91	0.23	0.00	0.00	0.00	85.7	2,197	0	0.000 ~
	May-Sep	Seine	0.00	0.13	9.76	43.52	26.32	17.07	2.44	0.64	0.00	0.13	125.5	779	1,462	11.648
19567	Oct-Dec	Seine	0.00	0.73	64.78	20.31	9.37	4.25	0.51	0.04	0.00	0.00	96.2	4,691	44,241	460.767
	Jan-Apr	Seine	0.00	1.42	64.96	21.83	7.50	3.97	0.31	0.00	0.00	0.00	95.7	826	8,202	84.577
	Jan-Apr	Trawl	0.12	2.24	71.93	14.15	4.60	5.66	0.94	0.24	0.00	0.12	91.7	848	0	0.000 ~
	May-Sep	Seine	0.00	3.46	18.92	40.97	25.30	9.95	1.08	0.11	0.11	0.11	129.9	925	7,165	55.146
19578	Oct-Dec	Seine	0.00	10.67	60.24	20.45	3.60	3.20	1.64	0.15	0.04	0.00	88.8	3,085	11,745	133.517
	Jan-Apr	Gillnet	0.00	24.49	53.06	18.37	0.00	2.04	0.00	2.04	0.00	0.00	76.1	49	0	0.000 ~
	Jan-Apr	Seine	0.00	9.97	61.67	16.52	4.36	3.66	3.24	0.49	0.09	0.00	90.1	1,850	6,982	84.814
	Jan-Apr	Trawl	0.00	12.72	73.29	11.64	1.88	0.45	0.01	0.01	0.00	0.00	74.8	527	695	9.491
	May-Sep	Seine	0.00	9.00	60.10	21.06	3.99	3.20	2.30	0.30	0.05	0.00	88.9	4,935 +	1,206	13.597
19589	Oct-Dec	Gillnet	0.00	24.49	53.06	18.37	0.00	2.04	0.00	2.04	0.00	0.00	76.1	49 +	381	5.002
	Oct-Dec	Seine	0.74	13.95	66.31	15.95	2.34	0.39	0.21	0.10	0.01	0.00	83.5	7,169	47,601	575.751
	Jan-Apr	Seine	0.86	14.21	65.57	16.41	2.29	0.39	0.21	0.06	0.01	0.00	82.4	7,215 +	146	1.770
	Jan-Apr	Trawl	1.52	19.81	59.43	18.10	1.14	0.00	0.00	0.00	0.00	0.00	70.9	525	0	0.000 ~
	May-Sep	Seine	0.00	25.55	57.59	10.98	3.72	1.52	0.27	0.29	0.09	0.00	79.4	1,506	1,897	23.636
19590	Oct-Dec	Seine	0.00	6.80	54.12	35.60	2.93	0.36	0.09	0.07	0.00	0.02	98.1	3,323	67,866	685.617
	Oct-Dec	Trawl	0.00	10.10	51.47	34.80	3.07	0.36	0.10	0.08	0.00	0.03	95.7	3,940 +	23	0.237
	Jan-Apr	Seine	0.00	23.34	50.24	24.15	2.11	0.00	0.16	0.00	0.00	0.00	79.8	617	149	1.863
19601	Oct-Dec	Seine	0.00	40.17	30.91	22.59	5.84	0.50	0.00	0.00	0.00	0.00	88.0	2,248	25,847	303.907
	Oct-Dec	Trawl	0.00	38.75	35.27	19.59	6.24	0.15	0.00	0.00	0.00	0.00	85.8	689	1,328	15.472
	Jan-Apr	Seine	0.00	31.62	24.51	25.79	16.10	1.87	0.11	0.00	0.00	0.00	80.6	1,145	9,335	115.270
	Jan-Apr	Trawl	0.00	38.75	35.27	19.59	6.24	0.15	0.00	0.00	0.00	0.00	85.8	689 +	586	6.822
	May-Sep	Seine	0.00	0.16	28.79	22.54	26.29	19.56	2.35	0.31	0.00	0.00	114.2	639	9,119	79.855
19612	Oct-Dec	Seine	0.00	9.92	71.21	12.79	4.02	1.72	0.33	0.00	0.00	0.00	88.8	2,824	53,725	602.612
	Oct-Dec	Trawl	0.00	9.56	71.49	12.85	4.11	1.59	0.35	0.04	0.00	0.00	89.0	2,824 +	785	8.818
	Jan-Apr	Seine	0.00	13.01	67.90	10.71	5.23	2.56	0.60	0.00	0.00	0.00	87.8	2,824 +	36	0.412
	Jan-Apr	Trawl	0.00	9.56	71.49	12.85	4.11	1.59	0.35	0.04	0.00	0.00	89.0	2,824 +	9	0.106
	May-Sep	Seine	0.00	9.42	71.71	13.00	3.96	1.57	0.32	0.02	0.00	0.00	88.8	2,824 +	10,747	120.280
19623	Oct-Dec	Seine	0.00	13.94	52.76	29.55	3.49	0.19	0.04	0.04	0.00	0.00	86.6	1,596	56,900	651.147
	Oct-Dec	Trawl	0.00	16.73	53.03	26.51	2.73	0.65	0.25	0.10	0.00	0.00	84.5	2,014 +	200	2.372
	Jan-Apr	Seine	0.00	31.58	47.44	15.39	2.88	1.78	0.72	0.35	0.00	0.00	82.2	1,874 +	5,014	71.016
	Jan-Apr	Trawl	0.00	16.73	53.03	26.51	2.73	0.65	0.25	0.10	0.00	0.00	84.5	2,014 +	47	0.562
	May-Sep	Seine	0.00	16.74	51.99	27.11	3.19	1.26	0.49	0.10	0.00	0.00	83.3	1,874 +	6,685	78.835
19634	Oct-Dec	Seine	0.00	4.30	63.37	29.55	2.20	0.47	0.05	0.07	0.00	0.00	103.4	3,255	65,538	626.573

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19634	Oct-Dec	Trawl	0.06	5.41	60.55	30.91	2.58	0.40	0.03	0.06	0.00	0.00	103.4	3,255	+	105	1.016
	Jan-Apr	Seine	0.06	5.19	60.54	31.14	2.58	0.40	0.03	0.06	0.00	0.00	105.7	3,255	+	878	8.440
	Jan-Apr	Trawl	0.06	5.41	60.55	30.91	2.58	0.40	0.03	0.06	0.00	0.00	103.4	3,255	+	208	2.011
	May-Sep	Seine	0.00	3.41	49.27	36.83	6.34	3.17	0.73	0.24	0.00	0.00	99.2	410		10,153	102.385
19645	Oct-Dec	Seine	0.00	20.04	54.60	22.98	2.07	0.28	0.00	0.03	0.00	0.00	103.0	2,555		39,050	388.413
	Oct-Dec	Trawl	0.00	14.53	56.86	25.79	2.14	0.61	0.03	0.03	0.00	0.00	104.3	2,939	+	36	0.349
	Jan-Apr	Seine	0.00	20.49	50.36	25.51	2.46	1.14	0.23	0.00	0.00	0.00	104.3	2,939	+	5,453	54.899
	Jan-Apr	Trawl	0.00	14.53	56.86	25.79	2.14	0.61	0.03	0.03	0.00	0.00	104.3	2,939	+	14	0.132
	May-Sep	Seine	0.00	16.35	55.51	25.09	2.26	0.77	0.67	0.04	0.00	0.00	104.0	2,939	+	3,266	31.893
19656	Oct-Dec	Seine	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529		27,909	231.771
	Oct-Dec	Trawl	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529	+	25	0.211
	Jan-Apr	Seine	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529	+	4,216	35.012
	Jan-Apr	Trawl	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529	+	18	0.146
	May-Sep	Seine	0.00	17.20	38.00	25.14	15.88	2.65	1.13	0.00	0.00	0.00	120.4	529	+	1,165	9.673
19667	Oct-Dec	Seine	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0	*	28,090	306.795
	Oct-Dec	Trawl	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0	*	1	0.008
	Jan-Apr	Seine	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0	*	1,694	18.499
	Jan-Apr	Trawl	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0	*	65	0.707
	May-Sep	Seine	0.00	36.90	45.72	12.18	3.21	1.59	0.29	0.05	0.06	0.00	91.6	0	*	1,193	13.031
19678	Oct-Dec	Seine	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0	*	1,031	10.881
	Jan-Apr	Seine	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0	*	58	0.616
	Jan-Apr	Trawl	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0	*	101	1.061
	May-Sep	Seine	0.00	30.37	50.62	14.68	3.04	0.88	0.18	0.23	0.00	0.00	94.8	0	*	700	7.390
19690	Oct-Dec	Seine	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0	*	1	0.007
	Jan-Apr	Gillnet	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0	*	22	0.230
	Jan-Apr	Seine	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0	*	220	2.299
	Jan-Apr	Trawl	0.00	25.64	60.32	9.49	3.27	0.72	0.56	0.00	0.00	0.00	95.5	0	*	0	0.004
19701	Oct-Dec	Gillnet	0.00	4.58	11.75	46.61	28.49	6.77	1.49	0.20	0.10	0.00	140.1	1,004	+	40	0.286
	Oct-Dec	Seine	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419		588	5.118
	Oct-Dec	Trawl	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419	+	95	0.828
	Jan-Apr	Gillnet	0.00	4.58	11.75	46.61	28.49	6.77	1.49	0.20	0.10	0.00	140.1	1,004	+	44	0.311
	Jan-Apr	Seine	0.43	13.36	41.17	34.74	7.01	2.58	0.67	0.04	0.00	0.00	113.9	1,419	+	857	7.672
	Jan-Apr	Trawl	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419	+	4	0.032
	May-Sep	Seine	0.35	12.33	40.03	36.36	7.12	2.82	0.92	0.07	0.00	0.00	114.8	1,419	+	66	0.577
19712	Oct-Dec	Seine	0.06	12.78	32.57	33.30	16.53	3.36	1.21	0.12	0.06	0.00	126.0	2,340		1,017	8.277
	Jan-Apr	Gillnet	0.00	5.92	11.45	45.25	28.69	6.90	1.65	0.14	0.00	0.00	139.8	1,004		456	3.275
	Jan-Apr	Seine	0.00	5.69	32.75	36.27	19.69	4.21	1.29	0.09	0.01	0.00	113.1	7,062		7,240	63.276
	Jan-Apr	Trawl	0.01	8.60	34.61	33.23	18.40	3.79	1.17	0.17	0.02	0.00	114.9	9,402	+	0	0.002
	May-Sep	Seine	0.01	4.41	29.73	34.98	23.32	6.08	1.39	0.09	0.01	0.00	117.3	9,402	+	98	0.815
19723	Oct-Dec	Gillnet	0.00	0.00	17.41	30.36	37.50	11.16	3.13	0.45	0.00	0.00	133.4	224	+	6	0.048
	Oct-Dec	Seine	0.00	3.37	50.48	20.94	18.35	5.39	0.91	0.45	0.11	0.00	120.6	1,071		256	2.082
	Oct-Dec	Trawl	0.10	1.89	31.61	30.52	23.07	11.01	1.51	0.26	0.03	0.00	130.6	5,777	+	1	0.008
	Jan-Apr	Gillnet	0.00	0.00	17.41	30.36	37.50	11.16	3.13	0.45	0.00	0.00	133.4	224	+	2,057	15.421
	Jan-Apr	Seine	0.08	1.98	36.48	29.31	20.75	10.01	1.24	0.14	0.01	0.00	130.3	4,643		5,161	41.003
	Jan-Apr	Trawl	0.10	1.89	31.61	30.52	23.07	11.01	1.51	0.26	0.03	0.00	130.6	5,777	+	0	0.000
	May-Sep	Seine	0.09	3.35	39.83	27.62	19.68	7.90	1.15	0.33	0.05	0.00	124.1	5,714	+	167	1.351
19734	Jan-Apr	Gillnet	0.00	0.00	3.74	43.04	32.01	17.56	3.21	0.43	0.00	0.00	157.1	924		3,095	19.692
	Jan-Apr	Seine	0.00	16.29	60.29	17.53	4.19	1.47	0.11	0.11	0.00	0.00	77.8	884	+	842	10.833
	Jan-Apr	Trawl	0.00	16.83	61.15	17.24	3.42	1.23	0.14	0.00	0.00	0.00	72.2	731		5	0.064
	May-Sep	Seine	0.00	16.29	60.29	17.53	4.19	1.47	0.11	0.11	0.00	0.00	77.8	884	+	62	0.795
19745	Oct-Dec	Seine	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685	+	218	2.243
	Oct-Dec	Trawl	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685	+	1	0.006
	Jan-Apr	Gillnet	0.00	0.00	4.88	46.34	32.32	12.80	3.05	0.61	0.00	0.00	150.1	164	+	5,331	35.526
	Jan-Apr	Other	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685	+	204	2.102
	Jan-Apr	Seine	0.36	3.87	57.31	27.80	7.04	2.49	0.77	0.23	0.13	0.00	98.1	5,685		575	5.995
	May-Sep	Seine	1.00	5.07	54.83	26.49	7.34	3.17	1.50	0.44	0.18	0.00	97.1	5,685	+	55	0.564
19756	Oct-Dec	Seine	0.06	7.34	23.01	40.08	20.31	5.57	2.38	0.79	0.43	0.04	122.7	3,494		4,313	35.358
	Oct-Dec	Trawl	0.03	7.28	21.54	41.65	19.99	5.44	2.59	1.01	0.39	0.07	120.3	5,918	+	3	0.021
	Jan-Apr	Gillnet	0.00	0.00	0.54	42.00	43.88	10.28	2.70	0.40	0.20	0.00	148.8	786		6,975	46.818

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19756	Jan-Apr	Other	0.03	7.28	21.54	41.65	19.99	5.44	2.59	1.01	0.39	0.07	120.3	5,918 +	205	1.704
	Jan-Apr	Seine	0.00	5.95	20.35	46.41	19.28	5.46	1.60	0.71	0.20	0.04	109.9	2,254	834	7.166
	Jan-Apr	Trawl	0.03	7.28	21.54	41.65	19.99	5.44	2.59	1.01	0.39	0.07	120.3	5,918 +	86	0.711
	May-Sep	Seine	0.03	7.45	21.69	41.20	20.01	5.53	2.57	1.04	0.40	0.07	119.8	5,748 +	28	0.238
19767	Oct-Dec	Seine	0.62	6.52	56.39	19.55	12.05	3.06	0.95	0.66	0.19	0.01	107.2	1,828	616	5.836
	Oct-Dec	Trawl	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	73	0.683
	Jan-Apr	Gillnet	0.00	0.00	3.50	27.75	47.32	16.68	4.08	0.54	0.15	0.00	150.3	1,658	7,736	51.507
	Jan-Apr	Other	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	569	5.343
	Jan-Apr	Seine	0.06	3.39	52.68	22.31	16.46	3.70	0.86	0.42	0.03	0.09	105.5	3,200	8,257	78.397
	Jan-Apr	Trawl	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	802	7.534
	May-Sep	Seine	0.36	3.76	52.98	21.04	15.51	4.16	1.25	0.62	0.20	0.12	106.5	5,028 +	25	0.236
19778	Oct-Dec	Gillnet	0.00	0.00	0.37	20.33	30.50	36.04	10.91	1.48	0.37	0.00	148.9	541 +	63	0.425
	Oct-Dec	Seine	0.06	2.53	36.75	40.07	9.39	7.18	3.08	0.56	0.35	0.03	110.2	1,984	10,648	96.197
	Oct-Dec	Trawl	0.03	1.31	35.05	42.37	11.19	7.52	1.95	0.34	0.15	0.08	107.9	5,891 +	1,792	16.618
	Jan-Apr	Gillnet	0.00	0.00	0.37	20.33	30.50	36.04	10.91	1.48	0.37	0.00	148.9	541	7,253	48.694
	Jan-Apr	Other	0.03	1.31	35.05	42.37	11.19	7.52	1.95	0.34	0.15	0.08	107.9	5,891 +	546	5.063
	Jan-Apr	Seine	0.00	0.42	34.65	42.60	13.62	7.09	1.22	0.32	0.00	0.08	105.6	3,516	3,919	36.641
	Jan-Apr	Trawl	0.03	1.31	35.05	42.37	11.19	7.52	1.95	0.34	0.15	0.08	107.9	5,891 +	296	2.746
	May-Sep	Seine	0.06	2.25	36.56	39.10	10.46	7.84	2.83	0.57	0.27	0.06	106.3	5,500 +	30	0.287
19789	Oct-Dec	Gillnet	0.00	0.00	1.15	23.14	54.68	13.77	5.54	1.53	0.00	0.19	153.5	523 +	7	0.048
	Oct-Dec	Seine	0.00	1.62	17.91	38.42	27.23	8.82	4.77	1.01	0.15	0.08	126.5	2,433	10,046	79.075
	Oct-Dec	Trawl	0.00	1.04	17.08	39.67	29.98	8.28	2.76	1.04	0.07	0.07	125.5	1,341	2,734	21.790
	Jan-Apr	Gillnet	0.00	0.00	1.25	22.00	55.02	14.11	5.74	1.66	0.00	0.21	153.8	523	6,818	44.171
	Jan-Apr	Other	0.00	2.11	19.98	36.69	27.50	8.16	3.95	1.11	0.31	0.18	123.2	7,108 +	364	2.954
	Jan-Apr	Seine	0.00	3.01	23.91	33.51	25.54	7.92	3.91	1.48	0.43	0.29	117.7	2,095	54	0.461
	Jan-Apr	Trawl	0.00	2.34	21.31	33.82	29.30	8.39	3.55	0.56	0.48	0.24	121.0	1,239	607	5.018
	May-Sep	Seine	0.00	2.25	20.19	36.76	25.68	8.39	4.95	1.27	0.31	0.20	120.8	4,528 +	71	0.587
19790	Oct-Dec	Gillnet	0.00	0.00	1.52	9.89	44.49	34.22	8.75	0.76	0.38	0.00	148.7	263 +	0	0.001
	Oct-Dec	Seine	0.30	2.02	42.12	22.71	18.78	9.35	2.56	1.54	0.47	0.15	114.6	3,063	1,188	10.051
	Oct-Dec	Trawl	0.00	3.30	46.70	22.21	15.90	8.60	2.01	1.29	0.00	0.00	108.4	698	242	2.234
	Jan-Apr	Gillnet	0.00	0.00	1.52	9.89	44.49	34.22	8.75	0.76	0.38	0.00	148.7	263 +	3,177	21.367
	Jan-Apr	Other	0.06	3.58	46.53	19.04	17.66	9.09	2.32	1.29	0.31	0.11	104.8	11,512 +	273	2.606
	Jan-Apr	Seine	0.00	4.54	41.60	20.45	20.27	9.00	2.55	1.29	0.25	0.05	100.2	7,664	903	9.224
	Jan-Apr	Trawl	0.00	3.31	49.04	22.17	14.65	7.90	1.78	1.15	0.00	0.00	107.1	785 +	254	2.373
	May-Sep	Gillnet	0.00	0.00	1.52	9.89	44.49	34.22	8.75	0.76	0.38	0.00	148.7	263 +	2	0.017
	May-Sep	Seine	0.15	4.03	43.30	19.97	19.34	8.73	2.59	1.42	0.37	0.11	102.3	10,727 +	52	0.514
19801	Oct-Dec	Seine	0.00	4.38	33.94	34.26	14.82	8.57	3.14	0.66	0.21	0.02	116.5	6,355	4,152	34.800
	Oct-Dec	Trawl	0.26	4.36	39.15	29.90	13.16	7.76	3.57	1.13	0.61	0.09	111.0	1,147	501	4.510
	Jan-Apr	Gillnet	0.00	0.09	2.19	18.16	22.98	37.37	16.05	2.81	0.26	0.09	152.1	1,140	5,067	33.319
	Jan-Apr	Other	0.02	7.86	37.75	30.48	11.48	8.21	3.21	0.71	0.26	0.04	106.0	19,963 +	409	3.860
	Jan-Apr	Seine	0.00	6.17	34.93	30.73	11.93	10.58	4.58	0.67	0.37	0.04	99.9	12,461	2,133	19.819
	Jan-Apr	Trawl	0.26	4.36	39.15	29.90	13.16	7.76	3.57	1.13	0.61	0.09	111.0	1,147 +	121	1.087
	May-Sep	Seine	0.00	4.80	38.21	36.28	10.06	7.77	2.22	0.46	0.15	0.03	96.4	18,816 +	79	0.813
19812	Oct-Dec	Seine	0.00	5.36	39.98	31.38	14.07	4.96	3.31	0.83	0.06	0.06	121.1	3,876	3,337	27.503
	Oct-Dec	Trawl	0.00	2.19	46.35	30.29	15.51	2.74	1.64	0.91	0.00	0.36	119.5	548	414	3.464
	Jan-Apr	Gillnet	0.00	0.00	4.60	15.77	30.37	15.82	20.42	11.58	1.03	0.41	150.9	589	5,583	37.004
	Jan-Apr	Other	0.00	5.74	37.68	27.80	17.93	4.66	4.14	1.65	0.32	0.08	112.4	9,756 +	455	4.049
	Jan-Apr	Seine	0.00	7.65	37.90	23.33	19.46	4.51	4.57	2.11	0.40	0.06	104.8	5,332	3,324	30.103
	Jan-Apr	Trawl	0.00	2.19	46.35	30.29	15.51	2.74	1.64	0.91	0.00	0.36	119.5	548 +	101	0.843
	May-Sep	Gillnet	0.00	0.00	4.58	15.96	30.56	15.11	20.88	11.71	0.85	0.34	151.6	589 +	0	0.001
	May-Sep	Seine	0.00	3.86	35.45	28.47	21.36	4.56	4.30	1.74	0.22	0.04	106.8	9,208 +	74	0.690
19823	Oct-Dec	Seine	0.00	3.37	34.06	30.39	16.43	8.12	2.93	3.00	1.43	0.26	116.0	5,296	632	4.809
	Oct-Dec	Trawl	0.00	1.59	19.36	35.99	17.54	12.07	3.87	5.01	3.87	0.68	144.1	439	115	0.797
	Jan-Apr	Gillnet	0.00	0.00	0.49	27.76	29.48	23.59	9.34	7.37	1.72	0.25	152.8	407	8,613	56.381
	Jan-Apr	Other	0.00	4.41	33.16	28.53	16.64	9.91	2.97	2.85	1.27	0.26	115.3	18,742 +	272	2.359
	Jan-Apr	Seine	0.00	3.36	31.41	28.72	17.68	11.49	3.16	2.78	1.16	0.24	113.5	13,007	7,798	69.556
	Jan-Apr	Trawl	0.00	1.59	19.36	35.99	17.54	12.07	3.87	5.01	3.87	0.68	144.1	439	0	0.000 ~
	May-Sep	Seine	0.00	10.91	42.05	22.39	12.44	7.63	1.95	1.76	0.72	0.14	109.6	18,303 +	57	0.568
	May-Sep	Trawl	0.00	1.59	19.36	35.99	17.54	12.07	3.87	5.01	3.87	0.68	144.1	439 +	2	0.017

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AGE										Mean	Number	CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19834	Oct-Dec	Seine	0.21	19.24	36.34	21.19	13.02	6.01	2.80	0.64	0.34	0.22	108.4	3,634	444	3.882
	Oct-Dec	Trawl	0.12	11.35	38.18	26.45	12.59	6.62	3.17	0.95	0.41	0.16	106.6	10,952 +	113	1.056
	Jan-Apr	Gillnet	0.00	0.00	7.14	30.29	30.95	19.05	9.39	1.59	0.66	0.93	142.9	756	6,039	42.246
	Jan-Apr	Other	0.12	11.35	38.18	26.45	12.59	6.62	3.17	0.95	0.41	0.16	106.6	10,952 +	182	1.708
	Jan-Apr	Seine	0.00	4.70	40.35	31.85	11.86	6.31	3.10	1.27	0.44	0.11	103.8	7,318	4,137	41.098
	Jan-Apr	Trawl	0.12	11.35	38.18	26.45	12.59	6.62	3.17	0.95	0.41	0.16	106.6	10,952 +	214	2.011
	May-Sep	Seine	0.15	10.57	39.21	27.00	12.16	6.30	3.13	0.95	0.39	0.14	105.9	10,952 +	88	0.843
19845	Oct-Dec	Gillnet	0.00	0.09	3.10	26.09	32.48	23.63	9.22	3.74	0.82	0.82	147.4	1,096 +	0	0.002
	Oct-Dec	Seine	0.00	32.93	37.34	18.72	6.75	2.89	0.91	0.34	0.11	0.00	101.9	2,528	409	3.904
	Oct-Dec	Trawl	0.00	25.68	43.11	18.61	7.60	3.21	1.20	0.51	0.06	0.01	93.7	10,799 +	20	0.218
	Jan-Apr	Gillnet	0.00	0.09	3.10	26.09	32.48	23.63	9.22	3.74	0.82	0.82	147.4	1,096	3,495	23.718
	Jan-Apr	Other	0.00	25.68	43.11	18.61	7.60	3.21	1.20	0.51	0.06	0.01	93.7	10,799 +	182	1.943
	Jan-Apr	Seine	0.00	23.09	43.51	19.33	8.62	3.55	1.27	0.55	0.07	0.00	90.8	8,187	2,770	29.011
	Jan-Apr	Trawl	0.00	25.68	43.11	18.61	7.60	3.21	1.20	0.51	0.06	0.01	93.7	10,799 +	246	2.630
	May-Sep	Seine	0.00	24.05	45.04	18.72	7.69	2.83	1.19	0.42	0.05	0.01	90.3	10,715 +	88	0.975
19856	Oct-Dec	Gillnet	0.00	0.00	2.50	35.62	33.44	16.51	8.49	2.60	0.57	0.26	145.1	1,920 +	0	0.000
	Oct-Dec	Seine	0.00	14.33	62.24	17.57	4.40	1.27	0.17	0.02	0.00	0.00	103.3	1,390	209	2.004
	Oct-Dec	Trawl	0.05	13.71	56.73	21.10	5.75	1.79	0.70	0.12	0.06	0.00	95.2	8,163 +	46	0.481
	Jan-Apr	Seine	0.01	9.76	55.76	24.98	6.45	2.06	0.80	0.12	0.08	0.00	94.7	6,773	178	1.844
	Jan-Apr	Trawl	0.05	13.71	56.73	21.10	5.75	1.79	0.70	0.12	0.06	0.00	95.2	8,163 +	120	1.257
	May-Sep	Seine	0.05	13.71	56.73	21.10	5.75	1.79	0.70	0.12	0.06	0.00	95.2	8,163 +	40	0.426
19867	Oct-Dec	Seine	0.10	23.34	34.77	30.50	8.84	1.75	0.46	0.23	0.00	0.00	104.8	1,148	104	0.984
	Jan-Apr	Gillnet	0.00	0.00	3.01	38.33	32.48	15.47	7.35	2.55	0.60	0.21	145.3	1,920	5,998	41.166
	Jan-Apr	Seine	0.03	2.73	32.98	38.23	19.76	4.32	1.22	0.45	0.19	0.10	97.6	7,957	3,133	32.258
	Jan-Apr	Trawl	0.03	11.82	33.27	35.95	14.21	3.23	0.99	0.34	0.11	0.05	98.6	9,105 +	76	0.768
	May-Sep	Seine	0.03	11.92	35.91	34.11	13.52	3.16	0.96	0.27	0.08	0.05	94.2	9,105 +	41	0.431
19878	Oct-Dec	Seine	0.41	6.52	64.47	14.59	11.38	1.81	0.55	0.15	0.11	0.00	106.4	1,632	357	3.386
	Oct-Dec	Trawl	0.06	4.74	61.47	14.71	14.27	3.60	0.90	0.19	0.06	0.00	100.5	7,970 +	83	0.826
	Jan-Apr	Gillnet	0.00	0.00	9.20	14.81	47.81	20.09	5.27	2.24	0.34	0.22	144.4	891	5,988	41.461
	Jan-Apr	Seine	0.00	2.35	52.89	17.58	20.29	5.27	1.31	0.21	0.10	0.00	104.0	6,338	1,475	13.516
	Jan-Apr	Trawl	0.06	4.74	61.47	14.71	14.27	3.60	0.90	0.19	0.06	0.00	100.5	7,970 +	279	2.773
	May-Sep	Seine	0.07	4.82	61.90	14.59	13.99	3.51	0.87	0.18	0.06	0.00	99.7	7,970 +	33	0.333
19889	Oct-Dec	Seine	0.00	26.15	17.44	42.75	6.77	5.90	0.82	0.16	0.00	0.00	109.1	1,252	728	6.660
	Oct-Dec	Trawl	0.01	12.64	17.97	51.78	8.95	6.86	1.47	0.28	0.03	0.01	102.2	7,769 +	134	1.308
	Jan-Apr	Gillnet	0.00	0.00	1.60	40.43	21.42	26.02	7.99	2.26	0.28	0.00	140.3	823	5,919	42.236
	Jan-Apr	Seine	0.00	12.31	15.17	51.91	10.87	7.93	1.48	0.27	0.04	0.03	104.6	6,517	1,446	13.339
	Jan-Apr	Trawl	0.01	12.64	17.97	51.78	8.95	6.86	1.47	0.28	0.03	0.01	102.2	7,769 +	86	0.844
	May-Sep	Seine	0.01	12.64	17.97	51.78	8.95	6.86	1.47	0.28	0.03	0.01	102.2	7,769 +	56	0.547
19890	Oct-Dec	Seine	0.00	6.68	58.62	12.72	17.67	2.26	2.05	0.00	0.00	0.00	101.3	928	75	0.736
	Jan-Apr	Gillnet	0.00	0.00	8.93	11.71	56.04	12.10	9.44	1.41	0.30	0.06	141.6	1,371	7,886	55.630
	Jan-Apr	Seine	0.00	10.09	57.87	8.23	17.43	3.59	2.27	0.40	0.07	0.06	100.2	5,915	96	0.936
	May-Sep	Seine	0.00	7.51	56.71	11.25	19.33	2.97	1.81	0.34	0.06	0.01	97.4	6,843 +	62	0.632
19901	Oct-Dec	Seine	0.00	13.89	31.24	38.58	7.67	7.42	1.04	0.16	0.00	0.00	107.5	698	371	3.440
	Oct-Dec	Trawl	0.00	10.74	23.31	39.87	8.80	13.78	2.05	1.27	0.17	0.02	108.1	5,989 +	122	1.133
	Jan-Apr	Gillnet	0.00	0.00	1.29	28.15	17.20	40.11	7.27	4.69	1.20	0.09	146.0	1,087	9,410	64.461
	Jan-Apr	Seine	0.00	3.82	21.09	44.52	10.27	16.08	2.48	1.47	0.24	0.03	109.4	5,291	1,141	10.217
	May-Sep	Seine	0.00	10.74	23.31	39.87	8.80	13.78	2.05	1.27	0.17	0.02	108.1	5,989 +	58	0.541
19912	Oct-Dec	Seine	0.00	3.96	67.09	17.24	9.27	1.31	0.56	0.56	0.00	0.00	103.6	641	639	6.140
	Oct-Dec	Trawl	0.00	4.95	56.44	14.07	15.80	3.22	4.63	0.58	0.28	0.02	104.1	5,677 +	128	1.229
	Jan-Apr	Gillnet	0.00	0.00	6.33	14.88	43.63	11.72	18.91	2.65	1.45	0.43	147.6	1,169	8,870	60.081
	Jan-Apr	Seine	0.00	3.62	53.63	14.96	17.44	4.04	5.34	0.59	0.38	0.00	105.6	5,036	3,725	34.318
	May-Sep	Seine	0.00	4.95	56.44	14.07	15.80	3.22	4.63	0.58	0.28	0.02	104.1	5,677 +	57	0.550
19923	Oct-Dec	Seine	0.00	26.95	31.11	31.47	6.97	2.56	0.26	0.58	0.11	0.00	98.6	973	516	5.272
	Jan-Apr	Gillnet	0.00	0.00	11.47	40.02	16.98	21.61	4.08	5.40	0.22	0.22	137.9	907	8,733	63.326
	Jan-Apr	Seine	0.00	11.22	39.18	33.15	7.57	5.77	1.37	1.63	0.06	0.06	101.3	5,445	4,396	42.070
	May-Sep	Seine	0.00	16.80	36.80	31.55	6.87	5.28	1.20	1.32	0.14	0.03	99.6	6,418 +	96	0.968
19934	Oct-Dec	Seine	0.00	5.65	50.00	25.43	16.30	1.52	1.09	0.00	0.00	0.00	101.3	460	866	8.549
	Jan-Apr	Gillnet	0.00	0.07	3.65	25.26	44.78	15.21	7.83	2.42	0.62	0.16	133.7	1,201	11,572	86.661
	Jan-Apr	Seine	0.02	3.72	42.96	26.98	19.34	3.70	2.65	0.53	0.13	0.00	97.2	5,969	5,138	52.868

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.4. Age composition and catch by season, fishery and gear type for the Strait of Georgia stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number	CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged	(tonnes)	(millions)
19934	May-Sep	Seine	0.02	4.74	42.74	26.61	18.59	3.81	2.69	0.65	0.14	0.00	97.4	6,429 +	71	0.730
19945	Oct-Dec	Seine	0.00	20.87	27.81	36.05	10.01	4.44	0.68	0.11	0.00	0.02	102.9	1,130	604	5.865
	Jan-Apr	Gillnet	0.00	0.00	2.10	27.82	38.15	24.14	5.10	2.10	0.30	0.30	139.6	927	8,190	58.655
	Jan-Apr	Seine	0.00	7.09	21.21	37.04	18.67	11.51	2.92	1.13	0.35	0.08	110.4	5,754	4,362	38.990
	May-Sep	Seine	0.00	11.65	22.69	35.69	16.39	9.89	2.37	0.93	0.29	0.10	107.9	6,884 +	33	0.306
19956	Oct-Dec	Seine	0.49	29.31	46.92	11.70	8.84	1.78	0.87	0.08	0.00	0.00	85.9	1,662	397	4.650
	Oct-Dec	Trawl	0.08	14.92	48.51	13.72	13.62	5.27	3.01	0.61	0.19	0.07	95.1	9,905 +	39	0.406
	Jan-Apr	Gillnet	0.00	0.00	4.05	15.87	44.53	22.08	10.30	2.11	0.84	0.21	138.2	544	6,233	45.214
	Jan-Apr	Seine	0.06	9.29	47.72	15.20	15.88	6.74	3.87	0.86	0.27	0.11	98.2	8,243	7,434	73.620
	May-Sep	Seine	0.08	14.92	48.51	13.72	13.62	5.27	3.01	0.61	0.19	0.07	95.1	9,905 +	10	0.106
19967	Oct-Dec	Seine	3.29	9.71	54.01	21.40	5.31	5.27	2.24	1.24	0.14	0.16	88.1	7,667 +	279	3.120
	Jan-Apr	Gillnet	0.00	0.00	4.74	17.85	16.43	31.91	17.06	8.53	2.53	0.95	136.7	633	6,148	44.974
	Jan-Apr	Seine	0.00	5.52	51.35	24.45	6.54	7.43	2.84	1.70	0.12	0.04	88.8	7,297	9,390	96.287
	May-Sep	Seine	0.65	8.74	52.26	22.45	5.78	6.09	2.41	1.42	0.13	0.07	91.7	7,667 +	7	0.071
19978	Oct-Dec	Seine	0.00	3.96	48.07	40.23	6.40	0.91	0.34	0.08	0.00	0.00	86.1	1,288	954	11.072
	Jan-Apr	Gillnet	0.00	0.00	1.54	26.20	28.32	15.61	18.69	7.13	1.54	0.96	130.4	519	6,895	52.858
	Jan-Apr	Seine	0.02	2.93	47.03	31.80	12.25	2.90	2.14	0.70	0.21	0.03	86.8	5,837	5,755	66.260
	Jan-Apr	Trawl	0.00	7.01	45.19	37.03	8.16	1.14	0.98	0.16	0.33	0.00	74.3	613	0	0.000 ~
19989	Oct-Dec	Seine	0.17	12.18	27.78	43.23	13.39	2.74	0.37	0.13	0.00	0.00	91.2	1,297	1,811	19.847
	Jan-Apr	Gillnet	0.00	0.00	2.15	29.31	36.72	21.05	6.70	3.35	0.60	0.12	130.8	836	6,837	52.248
	Jan-Apr	Seine	0.00	4.27	22.82	44.94	18.55	6.58	1.88	0.78	0.13	0.06	96.6	4,953	5,082	50.852
	Jan-Apr	Trawl	0.00	5.49	31.87	30.77	21.98	7.69	1.10	0.00	1.10	0.00	92.3	91	0	0.000 ~
	May-Sep	Gillnet	0.00	0.00	2.15	29.31	36.72	21.05	6.70	3.35	0.60	0.12	130.8	836 +	1	0.005
	May-Sep	Seine	0.03	7.18	25.52	41.65	17.73	5.66	1.50	0.58	0.10	0.05	94.8	6,250 +	5	0.058
19990	Oct-Dec	Seine	0.00	21.28	50.13	16.62	8.71	2.38	0.88	0.00	0.00	0.00	74.9	1,077	1,252	16.641
	Jan-Apr	Gillnet	0.00	0.00	1.08	13.93	44.67	28.49	9.45	1.97	0.40	0.00	134.4	1,179	10,425	77.334
	Jan-Apr	Seine	0.10	9.67	35.49	19.32	23.85	8.80	2.12	0.35	0.28	0.02	90.8	7,412	6,636	71.998
20001	Oct-Dec	Seine	0.00	9.66	51.94	27.98	5.52	3.51	1.25	0.00	0.13	0.00	95.6	797	1,423	14.897
	Jan-Apr	Gillnet	0.00	0.00	3.39	17.98	25.60	34.61	15.06	2.65	0.41	0.29	133.4	1,027	11,042	82.770
	Jan-Apr	Seine	0.00	4.80	42.65	30.65	9.52	9.19	2.52	0.55	0.09	0.02	97.3	4,558	7,275	74.770
20012	Oct-Dec	Seine	0.04	8.17	50.26	25.59	11.31	2.29	1.94	0.35	0.05	0.00	86.1	5,456 +	1,328	15.430
	Jan-Apr	Gillnet	0.00	0.00	5.83	20.78	30.42	17.69	21.01	3.54	0.49	0.24	131.8	915	7,986	60.800
	Jan-Apr	Seine	0.00	6.51	48.01	27.80	12.82	2.49	2.02	0.36	0.00	0.00	88.3	3,612	9,299	105.365

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.5. Age composition and catch by season, fishery and gear type for the West Coast Vancouver Island stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19501	Oct-Dec	Seine	0.10	15.78	39.08	37.78	5.35	1.56	0.26	0.05	0.05	0.00	96.8	1,927		7,670	79.266
	Jan-Apr	Seine	0.00	10.19	36.69	43.89	7.69	1.25	0.30	0.00	0.00	0.00	99.3	2,112		14,151	143.353
19512	Oct-Dec	Seine	0.11	6.62	61.99	20.85	9.27	0.89	0.27	0.00	0.00	0.00	98.9	996		8,251	83.215
	Jan-Apr	Seine	0.00	0.33	12.08	27.32	50.77	6.88	2.08	0.48	0.06	0.00	123.8	3,897		18,757	146.019
19523	Jan-Apr	Seine	0.16	11.77	57.76	28.08	1.67	0.50	0.05	0.00	0.00	0.00	82.4	3,764		20	0.242
19534	Oct-Dec	Seine	0.05	1.61	61.40	29.42	6.70	0.59	0.12	0.12	0.00	0.00	95.6	3,655		23,534	245.938
	Jan-Apr	Seine	0.00	4.43	65.53	24.81	4.06	0.83	0.21	0.04	0.04	0.04	87.2	2,439		9,675	109.814
19545	Oct-Dec	Seine	0.06	19.64	57.81	18.59	3.27	0.64	0.00	0.00	0.00	0.00	87.6	1,723		4,650	53.117
	Jan-Apr	Seine	0.00	10.86	65.09	20.01	3.47	0.52	0.05	0.00	0.00	0.00	80.9	754		1,473	18.369
19556	Oct-Dec	Seine	0.00	13.43	67.98	14.82	3.09	0.50	0.16	0.02	0.00	0.00	87.4	3,730		15,310	175.972
	Jan-Apr	Seine	0.00	9.21	49.51	19.28	17.88	3.68	0.11	0.11	0.22	0.00	87.2	923		1,787	20.496
19567	Oct-Dec	Seine	0.00	2.86	71.84	24.69	0.41	0.20	0.00	0.00	0.00	0.00	86.4	490	+	1,690	19.549
	Jan-Apr	Seine	0.00	2.74	71.92	24.81	0.35	0.18	0.00	0.00	0.00	0.00	86.4	588	+	915	10.586
	May-Sep	Seine	0.00	2.72	71.94	24.83	0.34	0.17	0.00	0.00	0.00	0.00	86.4	588	+	8	0.088
19578	Jan-Apr	Seine	0.00	15.18	54.28	25.87	3.98	0.47	0.17	0.04	0.01	0.00	76.8	1,480		513	6.766
	May-Sep	Seine	0.00	13.04	52.03	25.41	5.47	2.30	1.35	0.34	0.07	0.00	78.3	1,480	+	43	0.551
19589	Oct-Dec	Seine	0.00	3.26	45.21	29.96	14.51	3.46	1.82	1.45	0.33	0.00	92.2	2,843		55,196	588.911
	Jan-Apr	Gillnet	0.00	10.00	58.10	9.50	19.00	2.60	0.50	0.20	0.10	0.00	97.6	0	*	182	1.868
	Jan-Apr	Seine	0.00	3.28	19.68	23.88	26.94	9.15	7.94	6.52	1.99	0.62	99.6	751		13,845	136.204
19590	Oct-Dec	Seine	0.00	8.92	54.85	23.26	8.64	2.81	0.95	0.35	0.14	0.07	95.7	2,846		53,911	563.328
	Jan-Apr	Seine	0.00	8.92	54.85	23.26	8.64	2.81	0.95	0.35	0.14	0.07	95.7	2,846		0	0.000 ~
19601	Oct-Dec	Seine	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590	+	16,711	195.384
	Jan-Apr	Seine	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590	+	9,679	113.162
	May-Sep	Seine	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590	+	44	0.520
19612	Oct-Dec	Seine	0.00	4.82	82.29	9.63	2.41	0.86	0.00	0.00	0.00	0.00	93.2	1,163	+	5,951	63.821
	Jan-Apr	Seine	0.00	5.32	80.46	10.07	3.10	1.05	0.00	0.00	0.00	0.00	92.8	1,117		17,710	190.890
	Jan-Apr	Trawl	0.00	4.82	82.29	9.63	2.41	0.86	0.00	0.00	0.00	0.00	93.2	1,163	+	24	0.253
19623	Oct-Dec	Seine	0.00	1.99	43.18	48.71	5.16	0.75	0.21	0.00	0.00	0.00	101.3	1,862	+	3,184	31.449
	Jan-Apr	Seine	0.00	2.47	41.39	49.75	5.41	0.71	0.27	0.00	0.00	0.00	101.0	1,633		15,022	148.723
19634	Oct-Dec	Seine	0.00	1.64	60.61	25.86	10.83	0.77	0.29	0.00	0.00	0.00	103.4	1,107	+	2,952	28.550
	Jan-Apr	Seine	0.00	0.95	65.05	22.91	10.00	0.85	0.25	0.00	0.00	0.00	101.0	769		18,313	182.208
19645	Oct-Dec	Seine	0.00	2.78	34.38	48.44	10.07	3.99	0.35	0.00	0.00	0.00	122.5	576	+	68	0.553
	Jan-Apr	Seine	0.00	2.78	34.37	48.44	10.07	3.99	0.35	0.00	0.00	0.00	122.5	576		10,397	84.858
	May-Sep	Seine	0.00	2.78	34.37	48.44	10.07	3.99	0.35	0.00	0.00	0.00	122.5	576	+	5,582	45.559
19656	Oct-Dec	Seine	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0	*	4,299	31.377
	Jan-Apr	Seine	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0	*	6,471	47.228
	May-Sep	Seine	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0	*	73	0.535
19667	Oct-Dec	Seine	0.00	12.86	60.28	20.52	4.84	1.15	0.18	0.01	0.02	0.00	114.9	0	*	2,965	25.811
	Jan-Apr	Seine	0.00	12.86	60.28	20.52	4.84	1.15	0.18	0.01	0.02	0.00	114.9	0	*	9,794	85.253
	May-Sep	Seine	0.00	12.86	60.28	20.52	4.84	1.15	0.18	0.01	0.02	0.00	114.9	0	*	2,385	20.760
19701	Jan-Apr	Seine	0.00	5.77	44.57	36.95	7.85	2.77	1.62	0.46	0.00	0.00	132.8	433		0	0.000 ~
19712	Jan-Apr	Seine	0.00	3.66	19.01	50.10	21.81	3.39	1.23	0.79	0.03	0.00	135.3	1,482		6,894	51.001
19723	Jan-Apr	Gillnet	0.00	0.00	8.81	23.56	51.44	12.23	3.06	0.72	0.18	0.00	159.4	556		1,537	9.642
	Jan-Apr	Seine	0.00	0.21	25.15	23.05	35.64	13.81	1.89	0.17	0.08	0.00	139.1	2,556		16,766	117.326
19734	Jan-Apr	Gillnet	0.00	0.00	29.87	27.92	27.92	10.39	3.90	0.00	0.00	0.00	133.5	154	+	3,940	29.517
	Jan-Apr	Seine	0.00	5.71	43.66	22.09	15.14	10.96	2.32	0.12	0.00	0.00	114.9	5,221		12,394	109.083
19745	Jan-Apr	Gillnet	0.00	0.00	2.90	32.37	36.51	19.92	7.88	0.41	0.00	0.00	169.0	241	+	8,310	49.159
	Jan-Apr	Other	0.02	0.60	53.85	19.75	11.36	8.01	4.96	1.28	0.17	0.01	122.5	10,038	+	136	1.111
	Jan-Apr	Seine	0.02	0.44	51.61	19.95	12.00	8.70	5.71	1.38	0.18	0.00	124.6	10,038		17,798	142.327
	Jan-Apr	Trawl	0.02	0.60	53.85	19.75	11.36	8.01	4.96	1.28	0.17	0.01	122.5	10,038	+	0	0.004
19756	Jan-Apr	Gillnet	0.00	0.00	0.68	41.72	34.00	14.77	5.92	2.50	0.33	0.08	150.2	1,199		16,005	106.418
	Jan-Apr	Other	0.00	0.21	8.99	47.10	19.78	12.80	8.02	2.67	0.42	0.00	140.1	9,443	+	204	1.456
	Jan-Apr	Seine	0.00	0.20	8.31	48.06	19.79	12.97	7.65	2.57	0.43	0.00	140.0	9,230		22,820	162.893
	Jan-Apr	Trawl	0.00	0.47	14.55	54.46	18.78	6.10	5.16	0.47	0.00	0.00	131.6	213		0	0.000 ~
19767	Jan-Apr	Gillnet	0.00	0.60	3.61	17.47	43.37	16.87	11.14	5.12	1.51	0.30	154.2	332	+	12,556	81.452
	Jan-Apr	Seine	0.00	0.39	11.51	32.16	38.00	12.43	3.89	1.42	0.16	0.03	136.7	6,684		17,463	126.700
	May-Sep	Gillnet	0.00	0.60	3.61	17.47	43.37	16.87	11.14	5.12	1.51	0.30	154.2	332	+	24	0.154
19778	Oct-Dec	Seine	0.00	0.00	31.00	23.75	15.00	22.50	4.25	1.50	1.00	1.00	127.3	400		303	2.379
	Oct-Dec	Trawl	0.00	0.80	41.63	19.02	15.66	17.52	3.85	1.18	0.23	0.11	111.8	7,898	+	51	0.456

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.5. Age composition and catch by season, fishery and gear type for the West Coast Vancouver Island stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19778	Jan-Apr	Gillnet	0.00	0.00	1.42	5.45	21.33	49.05	17.54	4.74	0.24	0.24	157.6	422		14,755	93.615
	Jan-Apr	Seine	0.00	0.77	39.43	18.78	16.78	18.80	4.14	1.10	0.17	0.04	109.2	7,454		7,615	67.761
	Jan-Apr	Trawl	0.00	0.80	41.63	19.02	15.66	17.52	3.85	1.18	0.23	0.11	111.8	7,898	+	3	0.023
	May-Sep	Seine	0.00	0.80	41.49	19.07	15.66	17.60	3.85	1.18	0.23	0.11	111.9	7,854	+	7	0.066
	May-Sep	Trawl	0.00	0.80	41.63	19.02	15.66	17.52	3.85	1.18	0.23	0.11	111.8	7,898	+	11	0.101
19789	Oct-Dec	Seine	0.00	0.81	13.91	50.09	14.23	10.79	7.94	1.60	0.52	0.11	124.5	3,689	+	70	0.563
	Oct-Dec	Trawl	0.00	0.81	13.91	50.09	14.23	10.79	7.94	1.60	0.52	0.11	124.5	3,689	+	9	0.073
	Jan-Apr	Gillnet	0.00	0.00	1.05	24.79	28.57	23.74	18.07	3.15	0.42	0.21	161.5	476		8,138	50.388
	Jan-Apr	Seine	0.00	1.07	14.94	51.51	13.82	9.87	7.04	1.43	0.26	0.06	123.1	3,689		10,473	86.211
	May-Sep	Seine	0.00	0.81	13.91	50.09	14.23	10.79	7.94	1.60	0.52	0.11	124.5	3,689	+	4	0.032
19790	Jan-Apr	Gillnet	0.00	0.00	0.00	5.31	52.51	22.35	12.01	7.26	0.28	0.28	163.6	358	+	2,300	14.061
	Jan-Apr	Seine	0.00	7.13	37.93	13.75	20.24	8.99	8.11	3.14	0.48	0.23	110.8	3,735		1,682	14.641
	May-Sep	Seine	0.00	6.21	43.91	15.58	20.00	6.37	5.30	2.20	0.35	0.08	108.2	3,735	+	0	0.000
19801	Jan-Apr	Gillnet	0.00	0.00	1.78	21.00	14.95	36.30	18.86	7.12	0.00	0.00	148.6	281	+	3,079	20.725
	Jan-Apr	Other	0.00	4.62	37.17	28.31	9.93	12.00	5.19	2.05	0.58	0.16	114.1	5,026	+	46	0.403
	Jan-Apr	Seine	0.00	3.89	32.52	33.31	10.62	13.65	4.07	1.51	0.37	0.05	116.1	5,026		5,008	44.277
	May-Sep	Seine	0.00	2.83	27.39	22.26	14.13	17.84	8.83	4.77	1.41	0.53	133.6	566		2	0.015
19812	Jan-Apr	Gillnet	0.00	0.00	0.70	12.02	44.25	11.67	27.53	3.31	0.35	0.17	137.0	574		3,115	22.741
	Jan-Apr	Seine	0.00	4.32	24.84	28.55	22.53	5.50	7.92	3.73	2.04	0.58	120.4	4,775		2,370	19.713
	May-Sep	Seine	0.00	3.27	23.96	27.41	26.05	5.45	9.51	2.72	1.36	0.27	115.9	4,775	+	2	0.013
19823	Jan-Apr	Gillnet	0.00	0.00	0.35	14.19	23.82	44.83	6.48	9.81	0.35	0.18	137.8	571		2,434	17.662
	Jan-Apr	Seine	0.00	3.83	19.37	23.62	23.39	16.69	4.60	5.45	1.50	1.55	131.3	3,188		6,141	45.840
19834	Jan-Apr	Gillnet	0.00	0.00	1.68	6.72	17.98	32.61	31.93	5.38	3.36	0.34	154.9	595		858	5.540
	Jan-Apr	Seine	0.00	23.09	37.97	13.00	8.86	9.48	5.52	0.88	1.00	0.19	114.9	3,079		5,718	49.965
19845	Jan-Apr	Seine	0.00	6.28	48.74	22.86	6.40	5.12	6.21	3.47	0.37	0.55	120.1	2,995		177	1.352
	May-Sep	Seine	0.00	20.47	53.62	14.22	3.71	2.74	3.17	1.70	0.13	0.23	109.0	2,995	+	1	0.008
19856	Oct-Dec	Seine	0.00	3.78	50.45	29.70	8.29	3.13	2.24	1.76	0.58	0.07	121.5	4,151	+	1	0.005
	Jan-Apr	Seine	0.00	3.86	48.16	27.50	10.68	3.83	2.92	2.21	0.74	0.11	124.3	2,847		203	1.633
19867	Jan-Apr	Gillnet	0.00	0.00	1.82	24.55	61.82	5.45	2.18	2.91	0.91	0.36	171.3	550		2,471	14.431
	Jan-Apr	Seine	0.00	16.21	16.21	36.29	18.16	7.70	2.56	1.38	1.15	0.34	130.8	3,480		13,463	102.956
	Jan-Apr	Trawl	0.00	26.98	26.03	28.57	13.65	1.59	0.95	1.90	0.32	0.00	93.9	315		0	0.000 ~
19878	Jan-Apr	Gillnet	0.00	0.00	5.38	7.10	41.29	28.60	12.90	3.01	1.29	0.43	166.9	465		1,448	8.674
	Jan-Apr	Seine	0.00	1.60	63.80	7.41	14.70	8.38	2.75	0.65	0.48	0.23	127.5	4,883		8,276	67.129
	Jan-Apr	Trawl	0.00	3.03	59.09	19.70	15.15	3.03	0.00	0.00	0.00	0.00	92.9	66		0	0.000 ~
19889	Jan-Apr	Gillnet	0.00	0.00	0.20	54.50	11.00	22.30	9.40	1.60	1.00	0.00	151.0	382	+	3,515	23.274
	Jan-Apr	Seine	0.00	3.06	14.96	61.92	7.11	8.47	3.45	0.79	0.17	0.07	126.4	4,178		9,774	77.304
	Jan-Apr	Trawl	0.00	0.00	14.29	63.10	10.71	9.52	2.38	0.00	0.00	0.00	127.4	84		0	0.000 ~
19890	Jan-Apr	Gillnet	0.00	0.00	1.35	7.87	68.99	8.31	10.34	2.47	0.67	0.00	155.6	445		1,959	12.593
	Jan-Apr	Seine	0.00	0.46	26.32	11.72	48.79	4.89	5.99	1.53	0.27	0.03	139.4	3,720		7,890	56.611
19901	Jan-Apr	Gillnet	0.00	0.00	3.26	6.84	12.70	64.50	6.84	8.14	6.52	0.00	175.5	307	+	2,336	13.308
	Jan-Apr	Other	0.00	6.59	21.41	21.11	10.67	33.10	3.01	3.43	0.66	0.03	132.0	7,311	+	273	2.069
	Jan-Apr	Seine	0.00	6.15	19.13	22.02	10.60	35.06	2.99	3.39	0.64	0.02	130.8	5,715		6,299	47.096
19912	Jan-Apr	Gillnet	0.00	0.00	6.29	13.49	30.76	13.85	29.86	2.88	2.52	0.36	154.2	556		627	4.066
	Jan-Apr	Other	0.00	1.69	48.04	10.74	13.42	5.87	16.70	2.09	1.22	0.23	128.7	6,162	+	273	2.122
	Jan-Apr	Seine	0.00	1.47	43.29	10.77	14.97	6.62	18.95	2.42	1.26	0.26	132.2	4,290		3,086	23.337
	Jan-Apr	Trawl	0.00	3.45	31.03	20.69	26.44	2.30	10.34	2.30	2.30	1.15	105.6	87		0	0.000 ~
19923	Jan-Apr	Other	0.00	3.87	27.66	40.82	6.88	7.53	4.09	7.66	0.92	0.56	124.3	5,524	+	273	2.196
	Jan-Apr	Seine	0.00	3.46	26.25	39.83	7.14	8.29	4.57	8.71	1.08	0.66	126.9	4,705		5,612	44.244
19934	Oct-Dec	Trawl	0.00	3.00	22.74	24.13	30.04	8.00	5.00	5.26	1.58	0.24	124.7	6,274	+	0	0.001
	Jan-Apr	Gillnet	0.00	0.16	5.65	32.10	54.84	5.32	1.13	0.65	0.16	0.00	131.1	620		706	5.381
	Jan-Apr	Other	0.00	3.00	22.74	24.13	30.04	8.00	5.00	5.26	1.58	0.24	124.7	6,274	+	273	2.190
	Jan-Apr	Seine	0.00	3.85	18.47	22.30	31.82	8.69	6.19	6.58	1.84	0.27	125.3	6,196		5,332	42.481
	Jan-Apr	Trawl	0.00	6.41	25.64	37.18	12.82	12.82	3.85	0.00	1.28	0.00	92.4	78		0	0.000 ~
	May-Sep	Trawl	0.00	0.79	26.11	29.11	26.58	7.91	5.38	2.85	1.11	0.16	97.1	632		1	0.008
19945	Oct-Dec	Trawl	0.00	1.17	13.32	25.60	20.52	25.29	6.44	4.02	2.89	0.75	135.6	7,086	+	1	0.005
	Jan-Apr	Other	0.00	1.17	13.32	25.60	20.52	25.29	6.44	4.02	2.89	0.75	135.6	7,086	+	637	4.699
	Jan-Apr	Seine	0.00	1.02	13.98	21.55	19.83	27.32	7.46	4.66	3.26	0.93	139.0	5,392		1,947	14.006
	May-Sep	Trawl	0.00	2.57	34.57	29.07	10.02	13.75	4.52	3.93	1.57	0.00	105.9	574		3	0.029
19956	Oct-Dec	Trawl	0.00	14.66	22.14	12.66	19.38	12.53	13.75	2.82	1.25	0.81	119.5	8,255	+	1	0.006

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.5. Age composition and catch by season, fishery and gear type for the West Coast Vancouver Island stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE												CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Mean Weight	Number Aged		(tonnes)	(millions)
19956	Jan-Apr	Other	0.00	14.66	22.14	12.66	19.38	12.53	13.75	2.82	1.25	0.81	119.5	8,255	+	728	6.093
	Jan-Apr	Seine	0.00	17.06	22.43	12.83	15.22	12.76	14.03	3.39	1.42	0.86	119.3	5,394		790	6.607
	May-Sep	Trawl	0.00	14.66	22.14	12.66	19.38	12.53	13.75	2.82	1.25	0.81	119.5	8,255	+	0	0.000
19967	Jan-Apr	Other	0.01	3.23	69.98	8.14	4.10	6.01	4.44	3.22	0.56	0.32	100.4	8,540	+	728	7.249
	Jan-Apr	Seine	0.00	3.65	70.44	8.47	4.17	5.11	4.02	3.18	0.63	0.32	98.6	6,539		6,656	67.506
19978	Jan-Apr	Gillnet	0.00	0.00	0.86	41.37	10.51	10.55	14.67	12.41	6.33	3.29	138.6	899		1,550	11.177
	Jan-Apr	Other	0.00	2.49	22.75	59.49	6.52	2.75	2.95	1.79	1.01	0.26	98.7	7,055	+	364	3.689
	Jan-Apr	Seine	0.00	2.40	21.91	61.07	6.56	2.75	2.40	1.65	0.98	0.29	99.1	6,098		5,449	55.784
19989	Jan-Apr	Gillnet	0.00	0.00	0.82	9.98	60.36	18.46	5.32	3.35	1.48	0.24	135.7	1,043		963	7.098
	Jan-Apr	Other	0.00	1.44	21.90	24.90	38.57	8.09	2.66	1.49	0.63	0.32	106.2	5,562	+	455	4.285
	Jan-Apr	Seine	0.00	1.35	21.66	23.61	39.90	8.54	2.64	1.27	0.70	0.33	110.5	4,341		3,590	33.366
	May-Sep	Seine	0.00	1.44	21.90	24.90	38.57	8.09	2.66	1.49	0.63	0.32	106.2	5,562	+	0	0.000
19990	Jan-Apr	Gillnet	0.00	0.00	1.28	7.52	27.04	52.80	6.24	2.56	2.24	0.32	145.2	625		700	4.823
	Jan-Apr	Other	0.00	6.68	24.61	19.79	17.36	25.78	3.70	1.19	0.68	0.20	112.7	6,888	+	364	3.229
	Jan-Apr	Seine	0.00	5.97	25.15	19.61	17.87	25.60	3.66	1.19	0.74	0.21	115.1	6,613		1,356	11.965
20001	Jan-Apr	Other	0.00	7.02	45.66	20.20	8.38	7.57	9.44	1.32	0.21	0.21	105.3	2,352	+	364	3.456
	Jan-Apr	Seine	0.00	7.02	45.66	20.20	8.38	7.57	9.44	1.32	0.21	0.21	105.3	2,352		0	0.000 ~
20012	Jan-Apr	Gillnet	0.00	0.00	0.00	10.28	28.79	15.33	20.56	22.43	2.24	0.37	152.3	535		388	2.550
	Jan-Apr	Other	0.00	7.01	53.30	23.01	7.61	2.88	3.19	2.69	0.29	0.02	96.9	4,863	+	546	5.635
	Jan-Apr	Seine	0.00	4.14	51.73	22.77	9.91	3.00	4.36	3.73	0.36	0.00	103.0	2,200		433	4.204

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.6. Age composition and catch by season, fishery and gear type for the Area 27 stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19534	Jan-Apr	Seine	0.03	2.56	62.55	28.12	5.74	0.69	0.19	0.08	0.02	0.02	92.9	6,361	+	1,920	20.667
19545	Oct-Dec	Seine	0.00	2.77	35.29	52.50	7.55	1.48	0.33	0.08	0.00	0.00	99.0	1,412		5,939	58.757
	Jan-Apr	Seine	0.00	6.80	34.77	49.72	6.94	1.42	0.28	0.07	0.00	0.00	96.7	1,412		0	0.000 ~
19589	Jan-Apr	Seine	0.00	4.12	44.71	27.63	14.44	3.90	2.45	2.06	0.58	0.11	93.3	3,594	+	407	4.366
19601	Jan-Apr	Seine	0.00	38.31	37.97	19.15	4.41	0.17	0.00	0.00	0.00	0.00	85.5	590	+	1,149	13.434
19612	Jan-Apr	Seine	0.00	4.82	82.29	9.63	2.41	0.86	0.00	0.00	0.00	0.00	93.2	1,163	+	173	1.856
19623	Jan-Apr	Seine	0.00	1.99	43.18	48.71	5.16	0.75	0.21	0.00	0.00	0.00	101.3	1,862	+	31	0.304
19634	Jan-Apr	Seine	0.00	1.33	59.98	26.04	11.56	0.83	0.25	0.00	0.00	0.00	103.7	1,202	+	323	3.110
19645	Jan-Apr	Seine	0.00	2.51	31.20	46.10	14.62	4.60	0.42	0.28	0.28	0.00	125.8	718	+	769	6.113
19656	Oct-Dec	Seine	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0	*	125	0.913
	Jan-Apr	Seine	0.00	13.59	26.83	26.12	23.17	9.07	1.23	0.00	0.00	0.00	137.0	0	*	826	6.032
19667	Jan-Apr	Seine	2.43	20.71	55.46	16.68	3.43	0.80	0.26	0.19	0.04	0.00	106.7	0	*	51	0.482
19701	Jan-Apr	Seine	0.00	19.86	30.14	40.41	4.79	2.05	1.37	0.68	0.68	0.00	131.8	146		0	0.000 ~
19734	Jan-Apr	Gillnet	0.00	8.03	43.12	23.94	13.56	8.83	2.23	0.22	0.04	0.02	111.3	5,389	+	18	0.165
	Jan-Apr	Seine	0.00	8.03	43.12	23.94	13.56	8.83	2.23	0.22	0.04	0.02	111.3	5,389	+	508	4.562
19756	Jan-Apr	Gillnet	0.00	0.00	1.03	41.48	32.92	15.35	6.05	2.80	0.30	0.07	149.7	1,355	+	79	0.525
19778	Jan-Apr	Gillnet	0.00	0.00	1.42	5.45	21.33	49.05	17.54	4.74	0.24	0.24	157.6	422	+	75	0.477
	Jan-Apr	Seine	0.00	0.81	41.60	18.95	15.70	17.59	3.84	1.17	0.23	0.11	111.8	7,925	+	75	0.670
19789	Jan-Apr	Gillnet	0.00	0.00	0.93	27.43	27.61	23.32	17.35	2.80	0.37	0.19	159.6	536	+	270	1.695
	Jan-Apr	Seine	0.00	0.82	13.88	50.49	14.19	10.61	7.80	1.59	0.50	0.11	124.1	3,769	+	422	3.401
19790	Jan-Apr	Gillnet	0.00	6.28	46.56	15.12	18.71	5.93	4.93	2.07	0.32	0.07	106.6	4,014	+	519	4.873
	Jan-Apr	Seine	0.00	7.17	82.08	8.96	1.43	0.00	0.00	0.36	0.00	0.00	84.3	279		0	0.000 ~
19801	Jan-Apr	Gillnet	0.00	4.30	34.23	32.33	9.78	12.20	4.73	1.79	0.50	0.14	114.0	5,747	+	671	5.884
	Jan-Apr	Seine	0.00	2.08	13.73	60.33	8.74	13.59	1.53	0.00	0.00	0.00	113.6	721		0	0.000 ~
19812	Jan-Apr	Gillnet	0.00	0.00	0.63	11.62	44.58	11.77	27.63	3.30	0.31	0.16	137.7	637	+	332	2.411
	Jan-Apr	Seine	0.00	0.60	30.57	8.73	47.59	4.07	7.53	0.75	0.15	0.00	118.6	664		238	2.011
19823	Jan-Apr	Gillnet	0.00	0.00	0.31	13.52	22.73	47.00	5.99	9.98	0.31	0.15	138.0	651	+	163	1.181
	Jan-Apr	Other	0.00	4.23	22.50	22.13	21.59	17.97	4.32	5.35	1.03	0.88	127.9	3,289	+	91	0.712
	Jan-Apr	Seine	0.00	3.96	20.79	31.68	10.89	28.71	0.00	3.96	0.00	0.00	108.4	101		0	0.000 ~
19834	Jan-Apr	Gillnet	0.00	0.00	0.00	4.17	42.13	16.67	33.33	2.55	1.16	0.00	154.2	432		171	1.107
	Jan-Apr	Other	0.00	21.73	37.22	13.58	9.16	10.04	5.91	1.07	1.07	0.23	116.1	3,079	+	182	1.567
19845	Jan-Apr	Other	0.00	20.47	53.62	14.22	3.71	2.74	3.17	1.70	0.13	0.23	109.0	2,995	+	182	1.670
19856	Jan-Apr	Other	0.00	3.69	48.80	31.77	7.94	3.03	2.22	1.81	0.68	0.07	122.4	4,422	+	96	0.784
	Jan-Apr	Seine	0.00	2.21	23.62	63.47	2.58	1.48	1.85	2.58	2.21	0.00	136.5	271		0	0.000 ~
19867	Jan-Apr	Other	0.00	15.66	17.74	33.06	21.73	6.67	2.32	1.39	1.00	0.41	131.1	5,305	+	364	2.776
	Jan-Apr	Seine	0.00	17.02	27.66	15.96	35.46	1.06	0.00	1.06	0.35	1.42	131.2	282		0	0.000 ~
19878	Jan-Apr	Other	0.00	2.55	61.03	7.92	14.35	10.07	2.72	0.73	0.42	0.22	123.7	7,896	+	364	2.943
	Jan-Apr	Seine	0.00	2.16	62.53	11.05	6.20	15.36	1.62	0.81	0.00	0.27	121.3	371		0	0.000 ~
19889	Jan-Apr	Other	0.00	0.21	12.66	57.51	8.15	8.37	11.37	1.29	0.43	0.00	151.3	466	+	364	2.406
	Jan-Apr	Seine	0.00	0.21	12.66	57.51	8.15	8.37	11.37	1.29	0.43	0.00	151.3	466		0	0.000 ~
19890	Jan-Apr	Other	0.00	1.84	22.68	14.25	39.63	5.83	7.13	7.78	0.65	0.22	158.0	926	+	246	1.557
	Jan-Apr	Seine	0.00	1.84	22.68	14.25	39.63	5.83	7.13	7.78	0.65	0.22	158.0	926		0	0.000 ~
19901	Oct-Dec	Seine	0.01	6.71	22.27	20.52	10.65	32.59	2.99	3.50	0.73	0.03	131.8	7,680	+	0	0.001
	Jan-Apr	Other	0.01	6.71	22.27	20.52	10.65	32.59	2.99	3.50	0.73	0.03	131.8	7,680	+	246	1.867
	Jan-Apr	Seine	0.27	8.94	39.30	8.94	10.30	22.49	2.71	4.88	2.17	0.00	128.4	369		0	0.000 ~
19912	Jan-Apr	Other	0.00	3.48	71.21	11.21	3.40	2.91	5.04	0.99	1.28	0.50	116.9	1,410	+	364	3.115
	Jan-Apr	Seine	0.00	1.30	66.59	13.39	4.27	3.20	7.11	1.42	1.90	0.83	130.0	844		335	2.580
19923	Jan-Apr	Gillnet	0.00	0.00	3.28	53.28	14.09	7.92	7.53	11.58	0.97	1.35	146.6	518		367	2.502
	Jan-Apr	Other	0.00	11.30	35.79	38.93	5.02	1.57	1.41	5.02	0.31	0.63	108.5	637	+	364	3.356
	Jan-Apr	Seine	0.00	11.30	35.79	38.93	5.02	1.57	1.41	5.02	0.31	0.63	108.5	637		0	0.000 ~
19934	Jan-Apr	Gillnet	0.00	0.00	1.28	19.40	61.19	9.81	3.41	3.84	0.43	0.64	140.4	469		345	2.455
	Jan-Apr	Other	0.00	1.48	31.75	24.55	30.90	5.50	2.12	2.86	0.53	0.32	119.5	945	+	246	2.059
	Jan-Apr	Seine	0.00	1.48	31.75	24.55	30.90	5.50	2.12	2.86	0.53	0.32	119.5	945		0	0.000 ~
19945	Jan-Apr	Other	0.00	1.68	6.37	35.29	24.37	24.65	4.13	1.33	1.61	0.56	131.3	1,428	+	455	3.465
	Jan-Apr	Seine	0.00	1.29	6.83	30.93	27.19	25.26	5.28	1.55	1.29	0.39	130.6	776		88	0.670
	May-Sep	Trawl	0.00	1.68	6.37	35.29	24.37	24.65	4.13	1.33	1.61	0.56	131.3	1,428	+	0	0.000
19956	Jan-Apr	Other	0.00	10.19	24.60	7.91	20.91	17.75	14.76	3.16	0.35	0.35	120.9	569	+	364	3.011
	Jan-Apr	Seine	0.00	10.19	24.60	7.91	20.91	17.75	14.76	3.16	0.35	0.35	120.9	569		0	0.000 ~
	May-Sep	Trawl	0.00	10.19	24.60	7.91	20.91	17.75	14.76	3.16	0.35	0.35	120.9	569	+	0	0.000

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.6. Age composition and catch by season, fishery and gear type for the Area 27 stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE										Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)
19967	Jan-Apr	Other	0.00	4.01	76.83	7.32	1.57	4.01	4.70	1.57	0.00	0.00	89.9	574	+	96	1.068
	Jan-Apr	Seine	0.00	4.01	76.83	7.32	1.57	4.01	4.70	1.57	0.00	0.00	89.9	574		0	0.000 ~
19978	Jan-Apr	Other	0.00	2.45	23.38	59.06	6.46	2.66	2.94	1.81	0.99	0.25	98.4	7,343	+	273	2.775
	Jan-Apr	Seine	0.00	1.39	38.89	48.61	4.86	0.35	2.78	2.43	0.69	0.00	90.8	288		0	0.000 ~
19989	Jan-Apr	Other	0.00	7.76	28.03	33.82	24.87	4.08	0.53	0.53	0.26	0.13	86.9	760	+	96	1.104
	Jan-Apr	Seine	0.00	7.76	28.03	33.82	24.87	4.08	0.53	0.53	0.26	0.13	86.9	760		0	0.000 ~
19990	Jan-Apr	Other	0.00	2.30	54.36	24.20	9.65	7.50	1.23	0.15	0.46	0.15	89.9	653	+	96	1.068
	Jan-Apr	Seine	0.00	2.30	54.36	24.20	9.65	7.50	1.23	0.15	0.46	0.15	89.9	653		0	0.000 ~
20001	Jan-Apr	Other	0.00	6.99	43.76	21.39	8.71	7.93	9.46	1.30	0.24	0.24	104.3	2,548	+	96	0.921
	Jan-Apr	Seine	0.00	6.63	20.92	35.71	12.76	12.24	9.69	1.02	0.51	0.51	91.7	196		0	0.000 ~
20012	Jan-Apr	Other	0.00	7.49	62.74	15.63	10.06	0.64	2.36	0.86	0.21	0.00	96.7	467	+	32	0.331
	Jan-Apr	Seine	0.00	7.49	62.74	15.63	10.06	0.64	2.36	0.86	0.21	0.00	96.7	467		0	0.000 ~

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix 1.7. Age composition and catch by season, fishery and gear type for the Area 2W stock assessment region. These data are used for the age-structured model analysis.

			PERCENT AT AGE									Mean	Number		CATCH	
Season	Fishery	Gear	0+	1+	2+	3+	4+	5+	6+	7+	8+	9++	Weight	Aged		(tonnes)	(millions)	
19567	Jan-Apr	Seine	0.07	20.00	25.34	16.22	9.41	25.92	2.46	0.47	0.11	0.00	104.2	4,506	+	106	1.016	
19634	Jan-Apr	Seine	0.00	1.02	15.92	60.00	16.53	5.31	1.22	0.00	0.00	0.00	113.9	490	+	312	2.743	
19645	Jan-Apr	Seine	0.00	1.59	80.07	10.20	5.14	1.78	0.84	0.37	0.00	0.00	104.0	1,069	+	1,251	12.030	
19656	Jan-Apr	Seine	1.67	18.05	32.22	16.11	10.23	7.33	5.79	4.84	2.04	1.72	128.8	0	*	172	1.338	
19723	Jan-Apr	Seine	0.00	0.16	38.08	21.42	26.62	10.93	1.93	0.80	0.05	0.00	144.7	1,867	+	706	4.878	
19734	Jan-Apr	Gillnet	0.00	50.98	11.11	5.88	15.69	5.88	9.15	1.31	0.00	0.00	101.0	153		0	0.000	~
	Jan-Apr	Seine	0.00	0.61	31.47	38.54	17.89	8.36	2.58	0.49	0.06	0.00	126.9	1,627	+	403	3.178	
19745	Jan-Apr	Seine	0.00	0.63	26.50	34.13	27.01	9.18	2.05	0.41	0.09	0.00	130.8	6,384	+	449	3.436	
19756	Jan-Apr	Other	0.00	1.51	2.99	37.07	29.00	22.33	6.12	0.92	0.07	0.00	151.2	4,249	+	68	0.450	
	Jan-Apr	Seine	0.00	23.71	6.70	41.24	23.71	4.64	0.00	0.00	0.00	0.00	139.8	194		0	0.000	~
19778	Jan-Apr	Seine	0.00	0.15	23.63	18.15	9.48	28.96	13.11	5.04	1.26	0.22	150.5	1,350	+	575	3.819	
19789	Jan-Apr	Seine	0.00	1.49	18.84	22.95	16.23	22.95	13.81	1.87	1.12	0.75	151.9	536		691	4.546	
19790	Jan-Apr	Seine	0.00	0.37	76.03	13.11	4.49	3.37	1.87	0.00	0.75	0.00	108.8	267		0	0.000	~
19801	Jan-Apr	Other	0.00	4.51	3.77	67.99	11.90	5.72	3.90	1.41	0.67	0.13	133.0	1,487	+	91	0.684	
	Jan-Apr	Seine	0.00	4.98	1.87	66.92	11.97	6.35	5.02	1.79	0.84	0.26	132.9	1,232		770	5.808	
19812	Jan-Apr	Seine	0.00	0.02	53.90	2.31	34.93	3.91	2.55	2.02	0.23	0.13	139.5	1,654		1,225	9.099	
19823	Jan-Apr	Seine	0.00	0.50	1.52	68.64	3.59	20.49	2.37	1.43	0.83	0.64	151.9	3,356		2,518	16.808	
19834	Jan-Apr	Seine	0.00	6.45	1.61	0.60	35.28	2.42	51.01	1.81	0.60	0.20	166.2	496		0	0.000	~
19845	Jan-Apr	Seine	0.00	0.40	0.67	5.80	2.56	13.75	1.62	74.39	0.67	0.13	212.3	742		199	0.940	
19856	Jan-Apr	Seine	0.00	0.82	0.27	11.48	11.75	5.46	20.77	7.38	41.53	0.55	205.2	366		0	0.000	~
19867	Jan-Apr	Seine	0.00	22.14	61.32	0.25	1.27	1.27	1.27	8.14	1.02	3.31	112.0	393		0	0.000	~
19878	Jan-Apr	Seine	0.00	1.79	74.01	19.31	0.26	0.53	0.66	0.79	1.65	0.99	114.1	1,512		0	0.000	~
19889	Jan-Apr	Seine	0.00	0.49	3.42	76.06	15.88	0.49	0.49	0.98	0.81	1.38	137.6	1,228		0	0.000	~
19890	Jan-Apr	Seine	0.00	0.19	1.71	2.28	80.41	13.18	0.46	0.18	0.70	0.90	168.1	2,353		2,272	13.608	
19901	Jan-Apr	Seine	0.00	0.50	6.46	0.89	1.84	68.91	19.83	0.72	0.45	0.39	173.3	1,795		2,558	14.762	
19912	Jan-Apr	Seine	0.00	1.48	6.34	13.44	1.37	2.79	60.55	12.46	0.55	1.04	183.5	1,830		1,284	6.994	
19923	Jan-Apr	Seine	0.00	0.76	11.71	16.46	13.53	1.91	4.57	44.54	5.67	0.84	156.7	2,574		1,306	7.985	
19934	Jan-Apr	Seine	0.00	5.32	12.23	43.62	14.89	9.57	2.13	5.85	5.32	1.06	145.6	188		0	0.000	~
19978	Jan-Apr	Seine	0.00	18.50	34.75	23.10	18.68	2.62	0.63	1.53	0.18	0.00	120.8	1,108		180	1.487	
19989	Jan-Apr	Seine	0.00	15.60	32.38	28.09	14.30	7.28	1.56	0.52	0.26	0.00	116.8	769		0	0.000	~
19990	Jan-Apr	Seine	0.00	14.77	63.64	18.18	0.00	2.27	0.00	1.14	0.00	0.00	85.0	88		0	0.000	~
20001	Jan-Apr	Seine	0.00	4.37	8.48	40.62	24.42	12.08	6.94	2.06	0.51	0.51	153.2	389		0	0.000	~
20012	Jan-Apr	Seine	0.00	28.69	23.83	4.77	21.64	9.72	6.86	2.67	1.53	0.29	130.5	1,049		0	0.000	~

NOTE: * No biosample data available. Age composition and mean weight assigned from published reports.
+ Age composition calculated from biosample data aggregated from adjacent sections and/or fishery periods, by gear type.
~ No fishery openings this season. Age composition and mean weight obtained from pre-fishery charter biosamples.

Appendix table 2.1. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Queen Charlotte Is. stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	3477	2867	1415	289	165	78	0	0	0	6633	2510	0.10
1951/52	6104	2049	1653	702	132	74	35	0	0	8634	2398	-0.21
1952/53	27380	3441	1009	665	229	40	22	10	0	14885	5117	0.00
1953/54	3211	16135	2028	595	392	135	23	13	6	20391	9829	0.34
1954/55	3748	1883	9418	1155	334	219	76	13	11	45973	6161	-0.94
1955/56	1402	2204	1102	5483	669	193	127	44	14	7783	4114	0.43
1956/57	3630	820	615	288	708	54	16	10	5	1588	1578	1.06
1957/58	5842	1847	120	151	31	40	3	1	1	7868	787	-1.24
1958/59	1231	2026	802	45	44	8	11	1	0	9496	6941	0.75
1959/60	5097	717	779	367	18	17	3	4	0	18558	6470	0.01
1960/61	5452	3004	423	459	216	11	10	2	3	14310	6976	0.35
1961/62	8725	3210	1739	244	263	123	6	6	3	14035	4654	-0.04
1962/63	2928	5129	1703	828	105	109	51	3	3	16306	6176	0.10
1963/64	6934	1722	2515	738	307	37	38	18	2	4491	4223	1.01
1964/65	597	4068	716	712	117	35	4	4	2	3383	1446	0.22
1965/66	484	305	239	177	77	7	2	0	0	4673	2759	0.54
1966/67	1110	241	129	115	78	33	3	1	0	3878	710	-0.63
1967/68	1440	654	137	74	65	44	18	2	1	4113	747	-0.64
1968/69	2957	847	384	80	43	37	25	11	1	5466	1877	0.00
1969/70	6226	1743	499	226	47	25	22	15	7	12533	4303	0.00
1970/71	7217	3669	1027	294	133	28	15	13	13	33446	13616	0.17
1971/72	16181	4252	2158	604	173	78	16	9	15	25214	9951	0.14
1972/73	13940	9527	2416	1161	313	88	40	8	12	35389	7935	-0.43
1973/74	11856	8214	5414	1272	582	154	43	20	10	53518	10677	-0.54
1974/75	3206	6986	4690	2983	680	307	81	23	16	63315	8951	-0.89
1975/76	4076	1886	3970	2572	1585	357	161	43	20	51694	15413	-0.14
1976/77	4683	2399	1088	2042	1223	728	163	74	29	40520	12516	-0.11
1977/78	2973	2759	1255	541	930	535	317	71	45	26206	11511	0.24
1978/79	49687	1751	1451	603	226	366	208	124	45	15981	8488	0.43
1979/80	3487	29252	1010	682	236	83	132	75	61	63619	22107	0.01
1980/81	1410	2049	16964	575	358	118	41	66	68	80450	19213	-0.37
1981/82	1231	829	1192	9570	311	185	60	21	68	75706	19137	-0.31
1982/83	7848	723	476	680	5350	171	100	33	48	59295	18953	-0.07
1983/84	3224	4588	405	265	367	2850	91	53	43	42479	20511	0.34
1984/85	689	1889	2561	222	140	192	1480	47	50	32393	14450	0.26
1985/86	1364	401	1059	1362	111	67	91	706	46	25264	5637	-0.43
1986/87	12302	803	230	568	694	55	34	45	374	16980	9726	0.51
1987/88	3523	7246	454	123	290	348	28	17	210	20558	13228	-0.44
1988/89	1187	2073	4226	259	69	163	196	16	128	29738	22377	-0.28
1989/90	530	695	1190	2378	143	38	89	107	78	22558	23263	0.03
1990/91	3781	311	366	604	1093	62	16	38	79	12633	15061	0.18
1991/92	243	2204	168	178	265	453	25	7	48	11031	9990	-0.10
1992/93	200	142	1219	86	86	125	213	12	25	7076	5894	-0.18
1993/94	429	117	74	566	36	34	49	84	15	5155	11712	0.82
1994/95	1663	246	64	38	271	17	16	23	46	4116	4025	-0.02
1995/96	2277	980	145	38	22	160	10	9	41	6668	6646	0.00
1996/97	5865	1342	577	85	22	13	94	6	30	6823	9576	0.34
1997/98	359	3451	785	334	49	13	8	54	20	8896	18683	0.74
1998/99	1664	210	1899	403	161	23	6	4	35	7856	8466	0.07
1999/00	893	965	115	875	162	56	7	2	12	6293	4925	-0.25
2000/01	1530	513	520	54	370	66	23	3	6	8892	12757	0.36
2001/02	2797	895	289	298	31	209	37	13	5	5902	2029	-1.07

Estimated average availability at age (Si): 0.10 0.39 0.64 0.90 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.01 0.05 0.27 0.62 0.84 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 0.34

Estimated instantaneous natural mortality rate is 0.529

Appendix table 2.2. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Prince Rupert District stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	4175	5424	7623	1124	423	233	0	0	0	16801	30957	0.93
1951/52	4069	2667	2954	2813	313	89	49	0	0	5633	18726	1.52
1952/53	8612	2611	1520	842	478	26	8	4	0	15934	26417	0.82
1953/54	2916	5861	1723	997	546	308	17	5	3	6531	13289	1.03
1954/55	6685	1940	3376	560	220	79	44	2	1	8946	29031	1.49
1955/56	2659	4512	1250	1339	176	56	20	11	1	29541	15520	-0.33
1956/57	5011	1707	2480	722	733	92	29	10	6	8807	30006	1.54
1957/58	10646	3186	817	898	195	147	19	6	3	27997	10350	-0.68
1958/59	3403	6990	1978	505	538	114	86	11	5	27821	36608	0.59
1959/60	19662	2293	4322	1133	273	279	59	45	8	35121	20792	-0.21
1960/61	8778	12063	1386	2277	546	123	125	26	24	34743	12882	-0.67
1961/62	4625	5540	5658	618	859	178	40	41	16	39203	26095	-0.09
1962/63	14093	3023	3135	2931	291	374	78	17	25	30240	18886	-0.15
1963/64	2112	7745	1453	1364	1066	90	116	24	13	42665	30107	-0.03
1964/65	546	1355	3622	767	659	480	41	52	17	15652	6123	-0.62
1965/66	789	238	627	1406	233	158	115	10	17	6907	7487	0.40
1966/67	1220	537	120	242	422	55	37	27	6	4171	3694	0.20
1967/68	957	463	114	44	67	89	12	8	7	6455	7360	0.45
1968/69	3798	538	252	67	25	37	49	6	8	3134	906	-0.92
1969/70	2401	2586	366	172	46	17	25	33	10	11912	8390	-0.03
1970/71	1423	1610	1684	235	108	28	11	16	27	16288	8864	-0.29
1971/72	5772	951	956	1034	140	63	16	6	25	15681	9346	-0.20
1972/73	3602	3930	633	557	572	74	33	9	16	21485	12418	-0.23
1973/74	2573	2448	2637	414	359	366	48	21	16	28793	9336	-0.81
1974/75	1492	1751	1636	1679	248	210	213	28	22	30170	10894	-0.70
1975/76	2524	1014	1179	1073	1088	159	135	137	32	32341	14675	-0.47
1976/77	1295	1718	686	740	655	651	95	81	101	24803	10615	-0.53
1977/78	1227	881	1085	397	393	328	325	48	91	17999	4536	-1.06
1978/79	9210	831	561	602	193	173	144	142	61	14742	6994	-0.43
1979/80	1932	6265	534	325	323	98	87	72	102	31159	10315	-0.79
1980/81	2320	1310	4027	335	191	181	55	49	97	26095	11387	-0.51
1981/82	2885	1577	868	2547	204	112	106	32	85	28785	13893	-0.41
1982/83	8126	1960	1046	563	1630	129	71	67	74	31933	19771	-0.16
1983/84	1575	5531	1321	701	376	1084	86	47	94	31323	26255	0.14
1984/85	1501	1070	3681	857	437	222	613	49	80	30970	39123	0.55
1985/86	5422	1014	701	2312	509	237	107	296	62	30867	27801	0.21
1986/87	4500	3678	643	423	1263	258	116	53	176	28392	32573	0.45
1987/88	2494	3061	2405	405	239	646	126	57	111	24309	33365	0.32
1988/89	1346	1696	1960	1468	221	108	264	51	69	22647	13484	-0.52
1989/90	5691	914	1064	1185	781	91	39	96	44	22655	19209	-0.16
1990/91	6707	3873	574	658	683	409	45	19	69	25223	22340	-0.12
1991/92	1569	4563	2532	364	390	379	213	24	46	28535	35615	0.22
1992/93	720	1067	3015	1630	206	190	168	95	31	26123	21327	-0.20
1993/94	1861	489	695	1883	933	94	73	65	48	20070	13613	-0.39
1994/95	7298	1265	318	426	1079	484	40	31	48	17751	15486	-0.14
1995/96	3257	4963	835	203	258	620	262	22	43	30008	20487	-0.38
1996/97	4900	2216	3296	548	123	130	289	122	30	21153	21078	0.00
1997/98	1429	3335	1483	2153	306	45	26	59	31	24466	16271	-0.41
1998/99	4131	972	2231	974	1327	164	8	5	16	25823	25033	-0.03
1999/00	6050	2811	654	1448	611	774	88	4	11	24428	15478	-0.46
2000/01	3452	4114	1845	419	861	339	382	44	8	29963	31277	0.04
2001/02	3571	2347	2711	1199	257	435	158	178	24	27778	17868	-0.44

Estimated average availability at age (Si): 0.09 0.44 0.66 0.86 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.01 0.16 0.45 0.72 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 0.73

Estimated instantaneous natural mortality rate is 0.384

Appendix table 2.3. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Central Coast stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	1550	2997	3995	748	306	90	0	0	0	12989	18367	0.54
1951/52	2657	1085	1290	1291	167	60	18	0	0	2424	7433	1.32
1952/53	13463	1881	353	285	125	11	4	1	0	6800	15066	0.99
1953/54	1540	10131	1398	250	199	87	7	3	1	7115	12806	0.78
1954/55	1601	1026	5264	419	48	33	14	1	1	27304	11959	-0.63
1955/56	3721	1135	690	3133	234	27	18	8	1	6438	7557	0.36
1956/57	5319	2213	379	177	443	26	3	2	1	2503	4419	0.76
1957/58	6155	3680	680	93	23	43	3	0	0	12243	3238	-1.13
1958/59	1539	4325	1969	342	41	10	18	1	0	4709	3620	-0.07
1959/60	3141	1062	1993	541	56	6	1	2	0	23607	11976	-0.48
1960/61	7581	2127	694	1348	357	36	4	1	2	6637	3820	-0.36
1961/62	4393	5301	787	210	265	60	6	1	0	12903	12369	0.15
1962/63	3825	3180	3230	374	86	104	24	2	0	3684	6376	0.74
1963/64	2009	2868	1385	753	42	7	8	2	0	5308	6634	0.42
1964/65	1981	1149	839	372	117	5	1	1	0	3670	2213	-0.31
1965/66	4787	1397	446	244	68	18	1	0	0	1994	1640	0.00
1966/67	2140	952	129	93	20	3	1	0	0	3581	5773	0.67
1967/68	494	327	145	37	17	3	0	0	0	4585	6197	0.50
1968/69	1832	301	192	91	22	10	2	0	0	2871	2191	-0.07
1969/70	1817	1380	226	145	69	17	7	1	0	14806	10933	-0.11
1970/71	2171	1352	1026	168	107	51	12	5	1	16302	5193	-0.95
1971/72	3505	1595	910	677	107	68	32	8	4	11904	4246	-0.83
1972/73	2264	2607	985	456	297	45	28	13	5	22315	14804	-0.21
1973/74	3113	1698	1699	597	252	160	24	15	10	18956	9391	-0.51
1974/75	1468	2336	1224	1021	289	105	64	10	10	24409	8319	-0.88
1975/76	754	1102	1651	772	528	134	47	28	9	19181	15632	-0.01
1976/77	923	554	772	997	363	211	50	17	14	17461	16217	0.12
1977/78	687	693	355	466	480	145	80	19	12	5944	8453	0.55
1978/79	6437	516	409	160	109	54	12	7	3	7327	6073	0.01
1979/80	1202	4846	389	305	119	81	40	9	7	23128	14039	-0.30
1980/81	1239	904	3637	289	219	82	54	27	11	28550	16409	-0.36
1981/82	584	932	675	2643	196	131	43	29	20	32392	18173	-0.38
1982/83	493	436	669	469	1663	117	76	25	28	25157	16594	-0.22
1983/84	1806	370	315	459	296	988	67	44	31	15810	13678	0.05
1984/85	772	1347	256	198	257	150	479	33	36	16832	8487	-0.49
1985/86	1427	575	925	163	114	142	80	256	37	15791	18781	0.37
1986/87	8576	1067	403	608	101	69	84	47	173	15724	12251	-0.05
1987/88	615	6449	759	264	373	60	41	50	131	32644	26605	-0.20
1988/89	526	459	4620	521	172	233	37	25	112	32324	25759	-0.23
1989/90	1662	389	317	2970	294	89	114	18	67	29452	28525	-0.03
1990/91	8269	1247	269	208	1792	164	48	61	46	22399	17953	-0.22
1991/92	1003	6214	834	164	116	950	84	25	55	32088	41140	0.25
1992/93	1787	741	4262	534	98	67	539	48	45	31796	35458	0.11
1993/94	499	1323	504	2640	303	52	34	271	47	28958	30797	0.06
1994/95	1653	366	816	303	1441	156	25	16	154	17900	20322	0.13
1995/96	5776	1240	235	465	155	696	73	12	80	15669	18665	0.17
1996/97	5244	4301	852	145	267	87	387	41	51	22790	24999	0.09
1997/98	1200	3938	2970	561	92	164	52	233	55	27109	28919	0.06
1998/99	2218	899	2621	1824	323	51	84	27	148	27478	28458	0.04
1999/00	901	1665	612	1651	1064	180	24	40	83	26466	28487	0.07
2000/01	2414	676	1120	382	959	593	97	13	65	21145	22552	0.06
2001/02	792	1804	465	692	223	542	330	54	44	20859	17686	-0.17

Estimated average availability at age (Si): 0.14 0.54 0.77 0.95 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.03 0.20 0.49 0.75 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor (q) is 0.82

Estimated instantaneous natural mortality rate is 0.284

Appendix table 2.4. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the Strait of Georgia stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	16838	8128	3088	687	147	66	0	0	0	22458	67991	0.63
1951/52	19092	9637	2815	774	163	34	15	0	0	23864	70110	0.60
1952/53	33825	10661	3486	700	182	38	8	4	0	47214	105799	0.33
1953/54	20866	19571	5778	1826	365	95	20	4	2	33341	93421	0.55
1954/55	11983	12038	9011	1431	427	84	22	4	1	73591	78677	-0.41
1955/56	11257	6725	4418	3185	492	146	29	7	2	27083	33104	-0.28
1956/57	9383	6173	2083	986	664	100	30	6	2	16886	32030	0.16
1957/58	24673	5393	1217	409	178	116	18	5	1	10970	23045	0.26
1958/59	17541	14169	2170	310	99	42	28	4	2	27478	49782	0.12
1959/60	9183	9431	5409	580	79	25	11	7	1	31941	49896	-0.03
1960/61	22246	4951	2936	1348	137	18	6	2	2	20059	36720	0.13
1961/62	18939	11744	1861	707	306	30	4	1	1	22433	31289	-0.15
1962/63	18903	10526	3174	387	136	57	6	1	0	12120	38180	0.67
1963/64	9464	10008	3301	458	49	16	7	1	0	11675	28185	0.40
1964/65	4463	5182	2589	419	50	5	2	1	0	20693	28992	-0.14
1965/66	4320	2065	1073	586	89	10	1	0	0	5462	8628	-0.02
1966/67	3500	2018	521	149	71	10	1	0	0	5334	11134	0.26
1967/68	1787	556	224	71	17	8	1	0	0	6391	14543	0.34
1968/69	5391	971	264	108	34	8	4	1	0	15069	24593	0.01
1969/70	6342	3087	544	148	60	19	5	2	0	28984	51460	0.10
1970/71	4941	3677	1782	314	85	35	11	3	1	26593	55188	0.25
1971/72	5665	2856	2091	993	175	47	19	6	2	30000	30453	-0.46
1972/73	9709	3221	1410	961	447	78	21	9	4	23763	20558	-0.62
1973/74	12616	5633	1732	634	396	180	31	8	5	56509	66869	-0.31
1974/75	9621	7308	3197	900	315	193	89	15	7	59678	84726	-0.13
1975/76	16621	5582	4172	1723	403	128	77	36	9	49630	60100	-0.29
1976/77	12293	9625	3160	2046	751	164	51	31	18	68338	66351	-0.51
1977/78	6556	7103	5073	1503	848	283	60	19	18	55213	98994	0.11
1978/79	9376	3789	3666	2301	585	292	93	19	12	43380	61158	-0.14
1979/80	7276	5430	2041	1648	898	211	102	32	11	52021	80657	-0.04
1980/81	5867	4218	3041	1112	830	428	99	48	20	48463	50127	-0.44
1981/82	4461	3377	2250	1544	502	347	174	40	28	42134	92866	0.31
1982/83	3860	2559	1736	1079	681	197	132	66	26	21663	52728	0.41
1983/84	6168	2219	1246	642	300	166	39	26	18	17217	27626	-0.01
1984/85	9258	3536	1096	494	172	64	34	8	9	24038	22502	-0.54
1985/86	5294	5284	1880	498	177	50	18	9	5	44898	38036	-0.64
1986/87	16179	3067	3039	1080	286	102	29	10	8	36429	37030	-0.46
1987/88	4974	9359	1650	1502	441	94	27	8	5	51946	23221	-0.81
1988/89	12614	2880	5273	841	664	175	34	10	5	50128	60446	0.19
1989/90	6431	7299	1630	2787	381	270	66	13	5	69510	61317	-0.13
1990/91	16234	3732	4197	898	1326	158	106	26	7	52202	43391	-0.18
1991/92	11749	9412	2118	2202	406	524	57	38	12	67472	77753	0.14
1992/93	12453	6802	5189	1076	943	151	187	20	18	79001	85165	0.08
1993/94	6019	7154	3723	2632	473	367	54	67	14	60928	63910	0.05
1994/95	11638	3467	3872	1823	1050	146	99	15	22	52611	60556	0.14
1995/96	17728	6708	1904	1947	778	402	51	35	13	62821	66164	0.05
1996/97	20571	10179	3504	957	855	294	143	18	17	61897	54469	-0.13
1997/98	10121	11859	5364	1713	401	288	87	42	10	65602	70431	0.07
1998/99	17865	5847	6520	2731	757	144	67	20	12	68939	78764	0.13
1999/00	22912	10324	3216	3357	1271	302	47	22	11	68336	67608	-0.01
2000/01	32989	13196	5660	1641	1492	412	77	12	8	85009	94255	0.10
2001/02	17611	19095	7227	2889	689	509	115	22	6	116881	105845	-0.10

Estimated average availability at age (Si): 0.12 0.73 0.95 0.99 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.02 0.21 0.54 0.83 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 1.61

Estimated instantaneous natural mortality rate is 0.544

Appendix table 2.5. Estimates of numbers at age, spawning stock biomass (SB), spawn index (SI), estimated spawn-observed spawn residuals (RES), and other parameters from age-structured analysis for the west coast of Vancouver Island stock assessment region.

	Estimated numbers at age (x10-5) for period 1											
Season	1+	2+	3+	4+	5+	6+	7+	8+	9+	SB	SI	RES
1950/51	3176	2119	2592	386	99	43	0	0	0	17774	15791	-0.28
1951/52	4331	1818	691	932	126	32	14	0	0	1031	13080	2.38
1952/53	7370	2756	722	78	50	5	1	1	0	13963	28377	0.54
1953/54	4254	4742	1772	464	50	32	3	1	0	3535	16157	1.35
1954/55	6978	2649	955	281	48	5	3	0	0	6607	15872	0.71
1955/56	7586	4390	1363	506	145	25	2	2	0	11974	34517	0.89
1956/57	8591	4671	1775	589	207	59	10	1	1	44967	46962	-0.12
1957/58	11062	5521	2851	1090	360	126	36	6	1	39900	20514	-0.83
1958/59	7839	7110	3524	1820	696	230	81	23	5	12066	16424	0.14
1959/60	4060	4789	1868	625	229	80	27	9	3	3954	6165	0.28
1960/61	9845	2240	784	236	43	13	5	2	1	5048	7912	0.28
1961/62	4286	5370	562	149	33	6	2	1	0	14494	32628	0.65
1962/63	5696	2664	1810	183	43	9	2	0	0	7324	11933	0.32
1963/64	2146	3640	1092	481	41	9	2	0	0	9852	22962	0.68
1964/65	1856	1339	1336	309	117	10	2	0	0	6965	10863	0.28
1965/66	1928	1172	504	364	72	26	2	0	0	4081	3884	-0.21
1966/67	1014	1238	513	132	80	15	6	0	0	4245	5118	0.02
1967/68	1343	495	201	112	23	13	2	1	0	8408	9872	0.00
1968/69	6279	864	319	129	72	15	8	2	1	7931	9332	0.00
1969/70	11901	4040	556	205	83	46	9	5	1	23224	27333	0.00
1970/71	9325	7657	2599	358	132	54	30	6	4	28342	32432	-0.03
1971/72	11107	5999	4926	1672	230	85	34	19	7	63914	34829	-0.77
1972/73	11658	7130	3768	2899	974	134	49	20	15	77158	15844	-1.75
1973/74	18309	7492	4231	2035	1518	506	69	26	18	100989	25466	-1.54
1974/75	7660	11696	4361	2406	1092	798	265	36	23	119712	43611	-1.18
1975/76	4708	4920	6777	2394	1214	543	395	131	29	64788	62143	-0.21
1976/77	7776	3026	3026	3212	873	406	179	131	53	49083	55095	-0.05
1977/78	2378	4996	1800	1427	1305	324	149	66	67	42118	39338	-0.23
1978/79	5011	1524	2932	960	567	426	97	44	40	28019	63883	0.66
1979/80	3466	3217	866	1419	354	183	134	30	26	34704	60760	0.39
1980/81	1874	2225	2004	528	810	190	97	71	30	33332	54130	0.32
1981/82	1408	1191	1270	1111	257	373	84	43	45	25309	26505	-0.12
1982/83	2609	900	715	732	583	121	165	37	39	17427	13841	-0.40
1983/84	5431	1660	474	347	311	234	47	64	30	19239	22142	-0.02
1984/85	5315	3387	885	235	161	142	107	21	43	39636	27572	-0.53
1985/86	2098	3417	2172	568	151	103	91	68	41	49640	36633	-0.47
1986/87	12983	1349	2190	1393	364	97	66	58	70	33913	12644	-1.15
1987/88	2221	8206	701	1021	603	155	41	28	55	44437	40597	-0.09
1988/89	2752	1413	4876	381	529	309	79	21	42	44546	44682	0.00
1989/90	1602	1751	788	2538	183	247	143	37	29	37995	41468	0.09
1990/91	5038	1028	975	422	1292	92	123	72	33	25816	26960	0.04
1991/92	2547	3210	558	505	204	606	43	57	49	27992	38686	0.32
1992/93	1885	1634	1943	322	283	114	336	24	59	27661	31619	0.13
1993/94	879	1195	925	1063	173	151	61	179	44	20555	21007	0.02
1994/95	1445	553	669	479	524	83	72	29	107	17091	24788	0.37
1995/96	7057	928	331	381	269	293	47	40	76	15479	30902	0.69
1996/97	2146	4523	570	196	223	157	171	27	68	23591	42573	0.59
1997/98	1275	1362	2383	286	95	108	76	83	46	16747	39404	0.86
1998/99	1765	807	745	1148	126	35	35	25	42	13648	18498	0.30
1999/00	3234	1130	432	381	535	57	14	14	27	12576	11553	-0.08
2000/01	6429	2071	691	246	205	277	29	7	21	19512	12113	-0.48
2001/02	3974	4134	1317	437	155	129	175	18	18	30442	19154	-0.46

Estimated average availability at age (Si): 0.09 0.65 0.88 0.98 1.00 1.00 1.00 1.00 1.00

Estimated average relative selectivity at age for gillnet fisheries: 0.00 0.04 0.30 0.67 0.89 1.00 1.00 1.00 1.00

Spawn index-escapement conversion factor, pre-dive era (q) is 1.18

Estimated instantaneous natural mortality rate is 0.441

Appendix 3. 2003 recruitment forecast for West Coast Vancouver Island herring. Ron Tanasichuk, Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo, B. C.

The recruitment forecast is made using the methodology described in Tanasichuk (2002). It has two parts. The first forecasts the proportion of age 3 (recruit fish) in the incoming prespawning biomass. It is based on the linear relationship between the proportion of age 2+ herring trawled during August off the southwest coast of Vancouver Island and the proportion of age 3 fish "observed" by the RASM-2q herring stock assessment model (Schweigert 2002) in the prefishery biomass during the subsequent spring prefishery season. (The working aging convention is that birthdays occur at spawning time (March)). Statview (1999) is used for regression analyses. Proportion data are transformed using the logit transformation (Sokal and Rohlf 1995). Predictive regressions are re-expressed as geometric mean regressions (GMR) because both variables were measured with error (Ricker 1973). The regression is updated annually as new data appear.

The second part of the methodology consists of calculating the number of incoming age 3 recruits using the forecasted proportion age 3 from the regression and the number of returning adults (age 4 and older) forecasted by the stock assessment model. Number of age 3 fish in the (R_t) prefishery biomass is estimated as:

$$(1) \quad R_t = (N_t \bullet (1 - p_t)^{-1}) - N_t,$$

where N_t is the number of age 4 and older fish forecasted to be in the prefishery biomass and p is the proportion of age 3 fish forecasted from the offshore survey and t is prefishery year.

Data collection

Data for the 2003 forecasts are from the offshore survey done over August 4-7, 2002 using the R/V W. E. Ricker equipped with a midwater trawl. The southwest coast of Vancouver Island (Appendix Fig. 3.1) was surveyed intensively. Over 480 n.m. were steamed. Based on echosoundings, herring abundance appeared to be the highest over the time series of offshore surveys (1985-2002). Herring were located in fishing subareas 6, 7, 9, 11 and 12. Fish are traditionally seen in Bank (< 100 mm depth) subareas but the extensive distribution of herring in Subarea 11 has not been seen before. Herring were dispersed at depth rather than schooled.

Herring were captured in seven of the 10 midwater tows made. The catch was weighed. One-hundred and fifty fish were subsampled from each tow. Standard length (mm) was measured for all fish. In addition, for the first 25 fish, total mass (g) was measured and stomach contents were described and measured (mL). For most tows, scales from the first 100 fish were removed for aging by the Aging Laboratory at the Pacific Biological Station.

Identification of age 2+ (recruit) herring

Size of recruit herring has been varying dramatically since 2000 (Tanasichuk 2002). Consequently, scales have been collected since the 2001 offshore survey to develop real-time age-length histograms which are ultimately used to assign fish to age based on length. Appendix Fig. 2 shows the length distribution for age 2+ fish from tows where scales were taken. Results of Kolgomorov-Smirnov two sample tests showed that length-frequency distributions of age 2+ fish did not differ significantly ($p>0.57$) among tows (Tow 1 was excluded because only one age 2+ was identified). Similar results were obtained for all other ages.

Fish were assigned to age 2+ or not age 2+ using the methods described in Tanasichuk (2002). Age-length data were pooled over tows and stratified by 2 mm length intervals. For the pooled data, the proportion of fish at age j in length interval l was estimated as:

$$(2)\quad P_{j,l} = N_{j,l} \bullet N_l^{-1}.$$

Number of fish at age 2+ in each tow (N_{2+}) was then estimated as:

$$(3)\quad N_{2+} = \sum_{l=120}^{240} P_{2+,l} \bullet N_l.$$

Proportion of age 2+ fish in a sample in a given tow was estimated by dividing N_{2+} by the number of fish sampled. Appendix Fig. 3.3 shows the assignment of fish to age 2+ or not age 2+ for the 2002 survey. Appendix Table 3.1 presents catch information for the 2002 survey and the proportion of age 2+ fish estimated for each tow. The mean proportion of age 2+ fish, weighted by CPUE, was 0.17.

Retrospective analyses of recruitment forecasts

Appendix Table 3.2 shows a retrospective analysis of the regressions relating observed proportion age 2+ in the trawl samples to age 3 fish observed in the prefishery biomass during the subsequent spring. Regression parameter estimates are stable over time. Standard errors for the forecasted proportion age 3 ($\hat{S}_y$) were calculated using the equation given by Sokal and Rohlf (1995), where,

$$(4)\quad \hat{S}_y = \sqrt{S^2_{y \bullet x}\left[1 + \frac{1}{n} + \frac{(X_i - \bar{X})^2}{\sum x^2}\right]}$$

and $S^2_{y \bullet X}$ is the error mean square for the regression, n is the number of data pairs used to estimate the regression, X_i is the trawled proportion age 2+ for the forecast, and Σx^2 is the sum of the squared deviations for X. Observed proportion age 3 was within the 95% confidence interval for all 10 years evaluated retrospectively.

Incoming recruitments are assumed for all other B. C. herring stocks because there is no forecasting methodology developed for them. Recruitments are classified as Poor, Average or Good. Boundaries between Poor and Average, and Average and Good recruitments, are calculated as the 33 and 66 percentiles respectively of the cumulative frequency distributions of the forecast year-specific age 2+ abundance time series from the stock assessment model. By convention, recruitment to a B. C. herring stock is assumed to be Average. Poor or Good recruitments are assumed when a recruitment time series indicates a persistent (3-year trend) of one of those states of recruitment.

Appendix Table 3.3 gives the results of the retrospective analysis of the recruitment forecasts made using the methodogy. Results show that the forecasts were accurate in 8 of 10 years. The error for 1997 appears to be due to an inaccurate forecast of proportion age 3. The error for 1999 is a consequence of overforecasts of proportion age 3 and returning spawners. An Average recruitment assumption would have been accurate in 2 of the 10 years. If, by convention, recruitment for 1996 would have forecast to be Poor it would have been correct; however, recruitment would also have been forecast to be Poor in 1997.

Therefore, recruitment forecasts for WCVI herring are more accurate (8 of 10 cases) than invoking the recruitment assumption used by default for most other major B. C. herring populations (3 of 10 cases).

2003 recruitment forecast

Results of the 2002 offshore survey suggest that 0.17 of the number of fish trawled were age 2+. Consequently, using the regression based on data to the 2002 fishing season inclusive (Appendix Table 3.3, Appendix Fig. 3.4), 0.16 of the fish in the 2003 prefishery biomass is forecasted to be age 3. The stock assessment model forecast of the number of age 4 and older fish in the 2003 prefishery biomass is $2393 \bullet 10^{-5}$. Therefore, the forecasted number of age 3 herring is $456 \bullet 10^{-5}$. The current breakpoints between Poor/Average and Average/Good recruitments are $688 \bullet 10^{-5}$ and $1729 \bullet 10^{-5}$ fish respectively. Consequently, recruitment is forecast to be Poor.

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Appendix Table 3.1. Tow information, herring catch, proportion of age 2+ herring from midwater trawl tows along the southwest coast of Vancouver Island, 2002. Subareas are defined in Appendix Fig. 3.1.

Tow	Day	Month	Subarea	Catch (kg)	CPUE ($kg \cdot m^{-3}$)	Prop. Age 2+
1	4	8	9	3334	0.0225	0.17
2	5	8	6	454	0.00041	0.20
3	5	8	6	689	0.00101	0.13
4	5	8	6	713	8.2E-05	0.29
5	5	8	7	718	0.00512	0.18
6	6	8	12	84	2.2E-05	0.16
7	6	8	13.1	0	0	0
8	7	8	11	507	0.00103	0.28
9	7	8	2	4	0	0
10	7	8	4	0	0	0

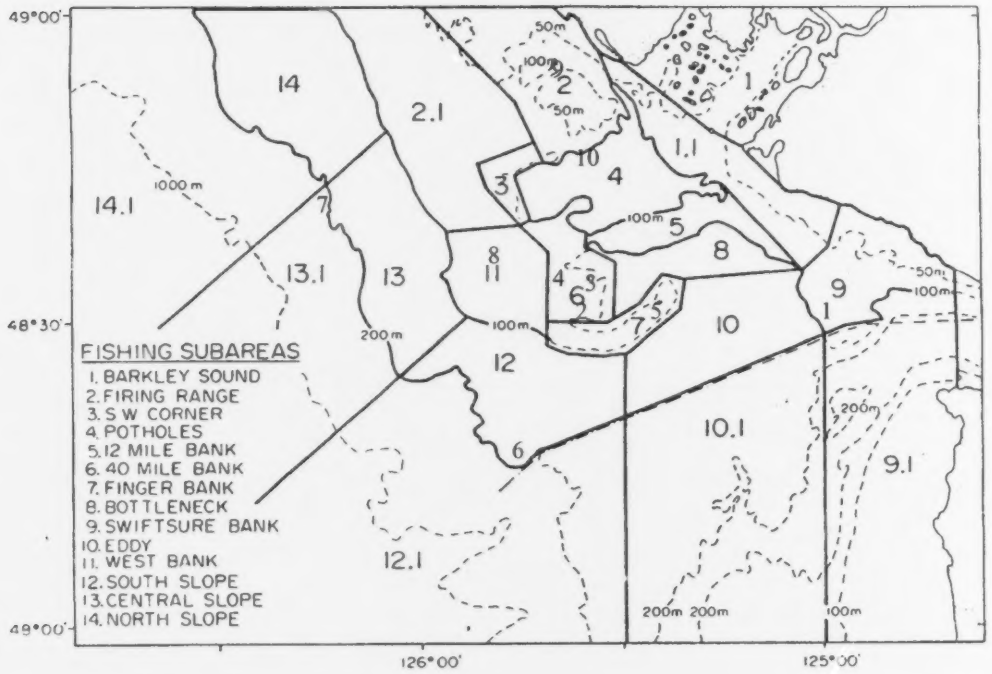
Appendix Table 3.2. Retrospective analysis of WCVI recruitment forecasting regressions. Regression statistics are for regressions based on all data up and including the year of trawling. Regressions were used to forecast proportion age 3 fish in year x+1 based on trawled proportion age 2+ in year x. Forecasted proportion and 95% CL for the prediction for year+1 appear in the entry for year x+1. For example, the regression statistics for 1991 appearing in the entry for 1991 were calculated using all data pairs to 1991 inclusive. This regression was used with the trawled proportion age 2+ (0.16) for 1992 to predict that the proportion age 3 in the 1993 prefishery biomass would be 0.16. The observed proportion age 3 was 0.29. Regression analyses began with five years of data because smaller sample sizes were considered to be inadequate. β, α - predictive regression slope and intercept respectively. β', α' - GMR regression slope and intercept respectively.

Year	Prop. Age 3		Regression statistics									Lower 95%		Upper 95%
	Trawled (Year)	Obs. (Year+1)	β	s_β	p	β'	α	s_α	p	α'	R^2	CL	**Estimate**	CL
1986	0.19	0.16												
1987	0.46	0.72												
1988	0.25	0.15												
1989	0.25	0.24												
1990	0.10	0.18	1.20	0.537	0.11	1.52	0.42	0.735	0.61	0.80	0.62			
1991	0.62	0.53	0.93	0.346	0.05	1.16	0.02	0.438	0.96	0.24	0.64			
1992	0.16	0.29	0.85	0.314	0.04	1.10	0.03	0.417	0.94	0.29	0.60	0.03	0.16	0.52
1993	0.24	0.25	0.86	0.287	0.02	1.11	0.02	0.375	0.96	0.28	0.60	0.08	0.27	0.65
1994	0.27	0.16	0.85	0.294	0.02	1.15	-0.08	0.375	0.85	0.24	0.55	0.09	0.3	0.65
1995	0.25	0.25	0.85	0.275	0.01	1.15	-0.08	0.347	0.82	0.23	0.55	0.08	0.26	0.61
1996	0.34	0.71	0.95	0.335	0.02	1.39	0.16	0.408	0.70	0.60	0.47	0.13	0.37	0.71
1997	0.19	0.25	0.94	0.313	0.01	1.37	0.16	0.388	0.68	0.61	0.48	0.04	0.19	0.58
1998	0.14	0.21	0.92	0.285	0.01	1.32	0.15	0.369	0.69	0.59	0.48	0.03	0.13	0.46
1999	0.42	0.31	0.84	0.270	0.01	1.26	0.02	0.337	0.94	0.46	0.45	0.19	0.54	0.86
2000	0.38	0.48	0.87	0.256	0.005	1.26	0.07	0.310	0.82	0.48	0.47	0.15	0.46	0.81
2001	0.61	0.52	0.80	0.200	0.01	1.10	-0.15	0.236	0.54	0.13	0.53	0.34	0.74	0.94
2002	0.17											0.04	0.16	0.49

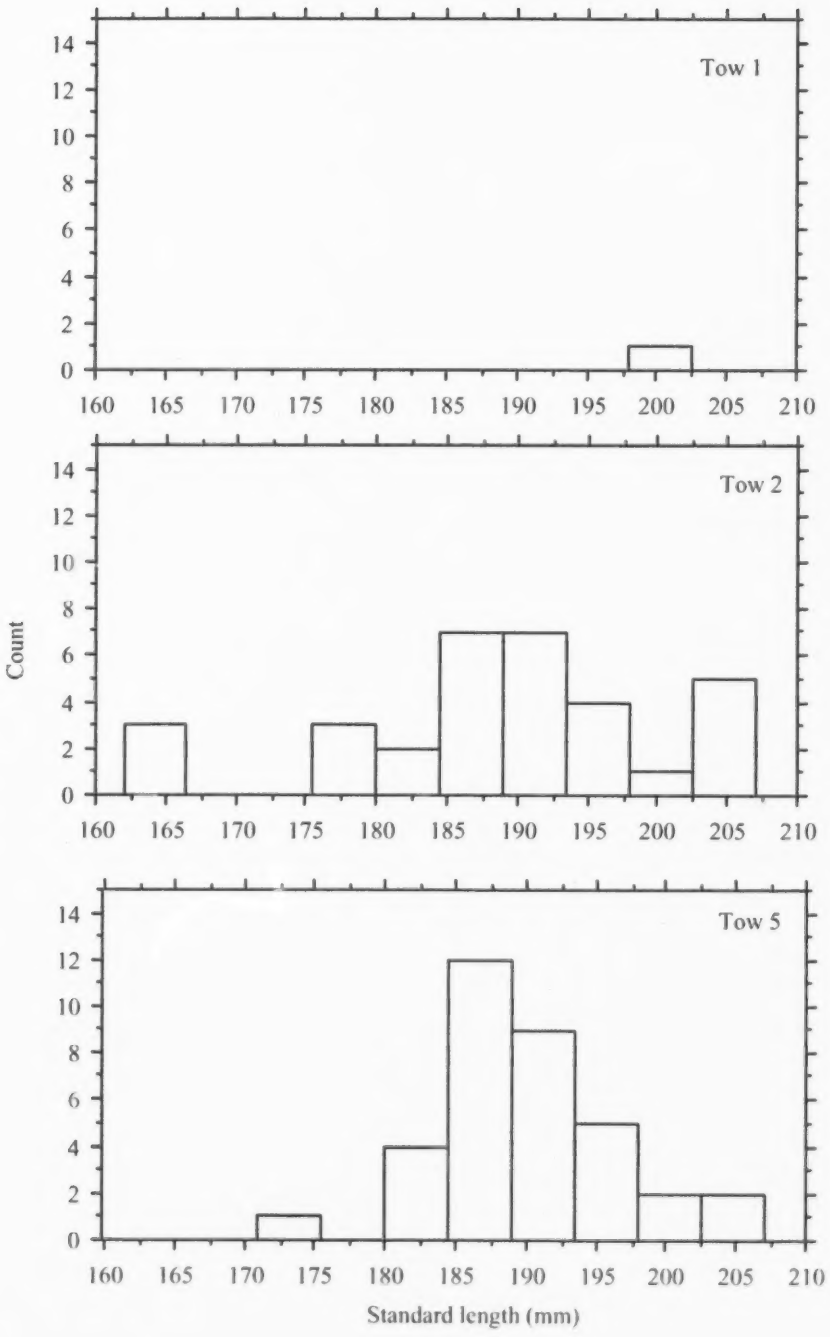
Appendix Table 3.3. Retrospective recruitment forecasts for WCVI herring, 1993-2002. Numbers of fish - $\bullet 10^{-5}$. All observed estimates are age-structured model output and are multiplied by year-specific survival and age x year-specific availability to generate

prefishery estimates. Recruitment distribution breakpointsfor Poor/Average (p=0.33) and Average/Good (p=0.67) are from age 2+ time series for the 1992-2001 forecasts. APE – absolute percent error, $\left((observed - forecasted) \bullet observed^{-1}\right) \bullet 100$.

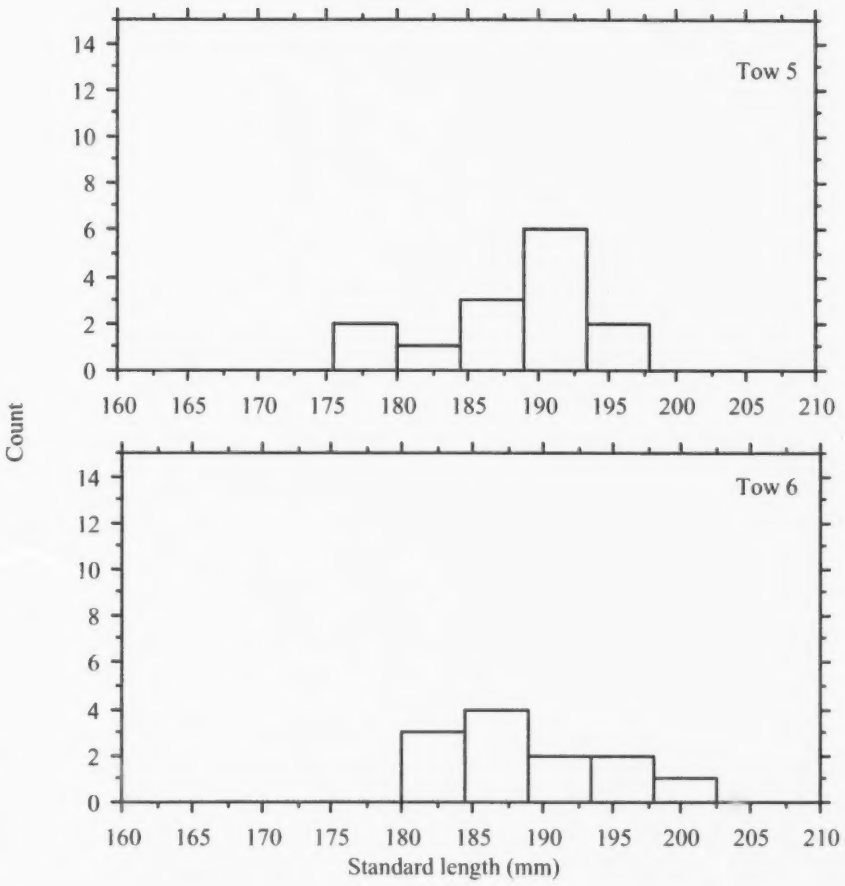
	Proportion age 3		Forecast		Observed		Proportion age 3		No. age 4++			
Season	Forecast	Observed	Number	Category	Number	Category	Residual	APE	Observed	Forecast	Residual	APE
1993	0.16	0.29	331	Poor	785	Poor	-0.13	0.81	1928	1737	191	0.10
1994	0.27	0.25	665	Poor	521	Poor	0.02	0.07	1718	1798	-80	0.05
1995	0.30	0.16	576	Poor	249	Poor	0.14	0.47	1586	1343	243	0.15
1996	0.26	0.25	434	Poor	444	Poor	0.01	0.04	1346	1234	111	0.08
1997	0.37	0.71	759	Average	3102	Good	-0.34	0.92	1284	1292	-8	0.01
1998	0.19	0.25	736	Average	1018	Average	-0.06	0.32	3586	3136	450	0.13
1999	0.13	0.21	460	Poor	691	Poor	-0.08	0.62	2335	3082	-747	0.32
2000	0.54	0.31	2261	Good	452	Poor	0.23	0.43	1370	1926	-556	0.41
2001	0.46	0.48	1021	Average	993	Average	-0.02	0.04	1042	1199	-157	0.15
2002	0.74	0.52	4353	Good	1741	Good	0.22	0.30	1343	1529	-187	0.14
Mean							0.01	0.39			-106	0.17



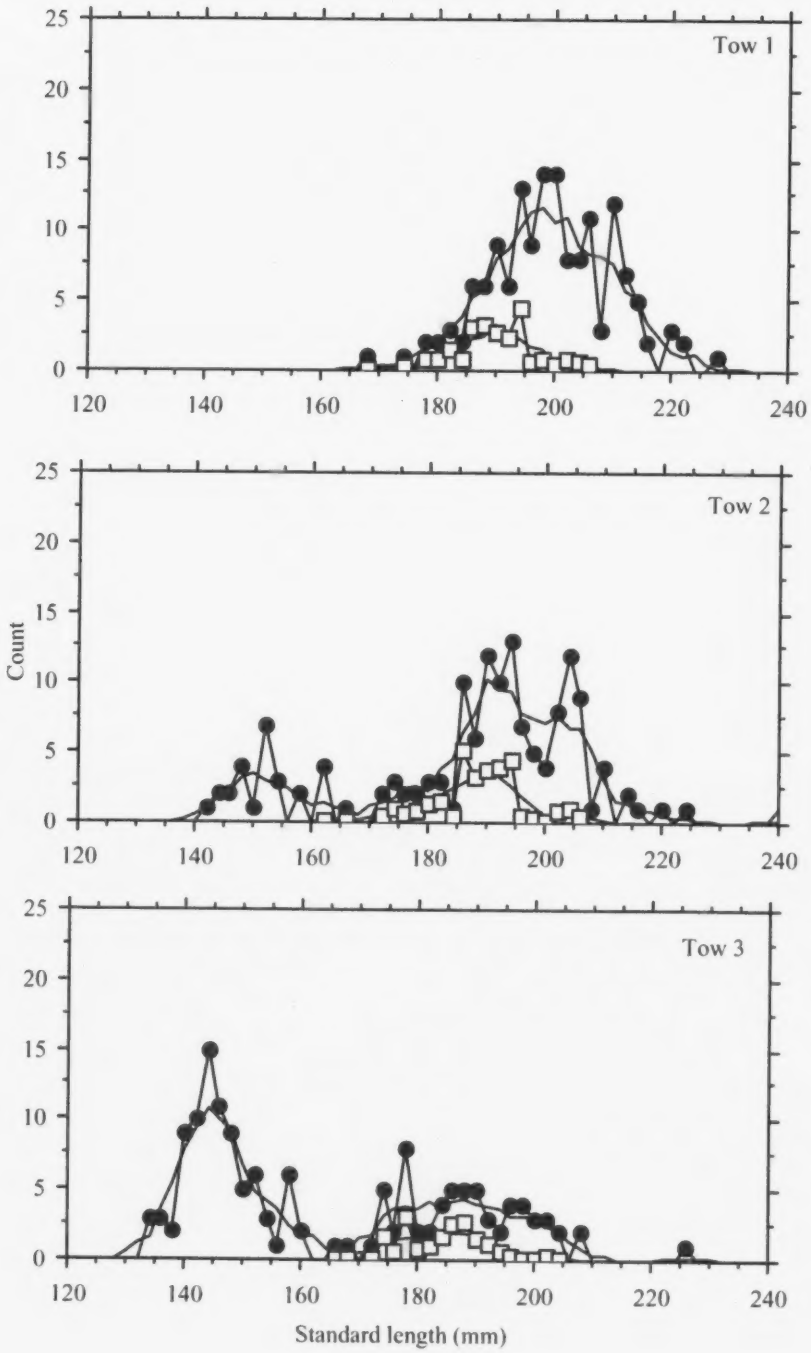
Appendix Figure 3.1. Laperouse study area. Outlined numbers are tow locations for August 4 – 7, 2002 survey.



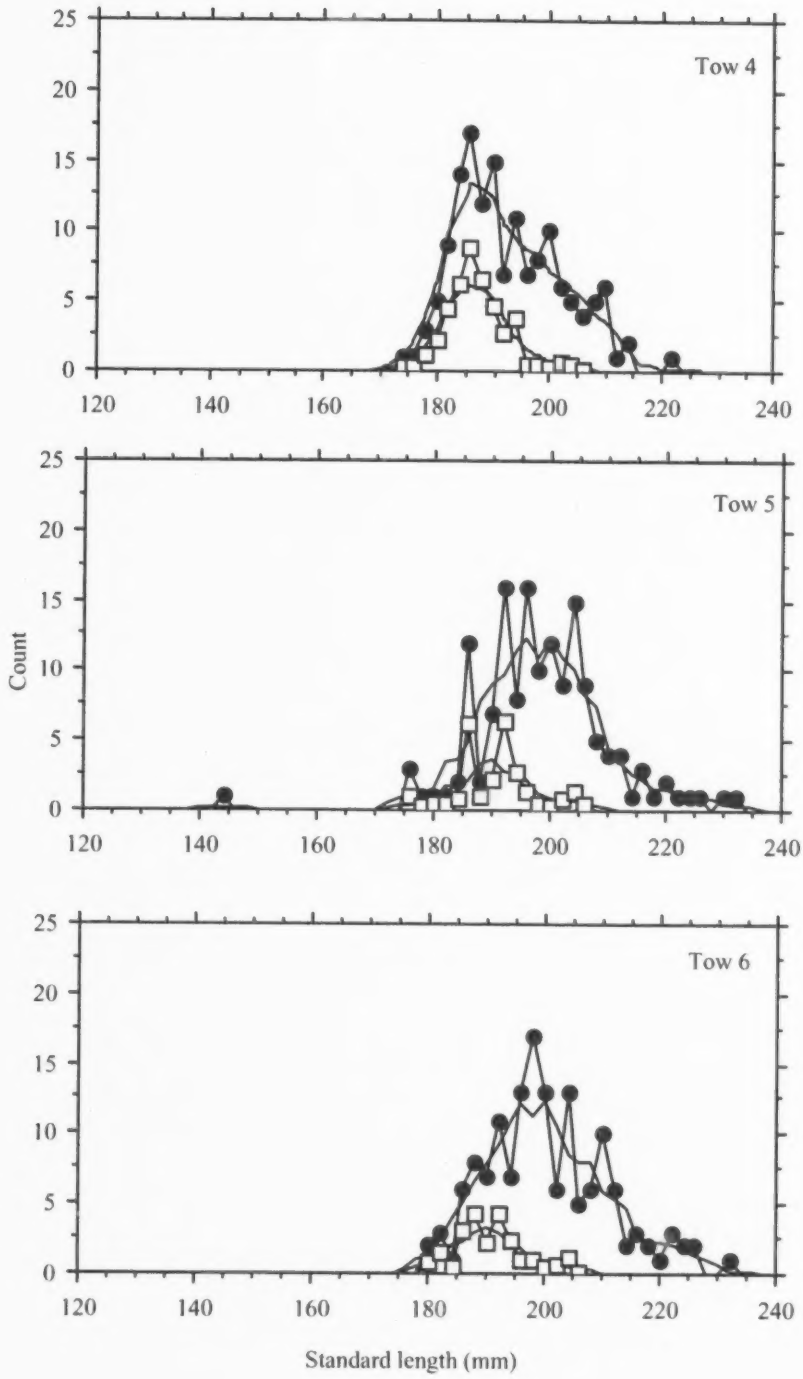
Appendix Figure 3.2. Length distributions of age 2+ herring collected during the 2002 offshore survey.



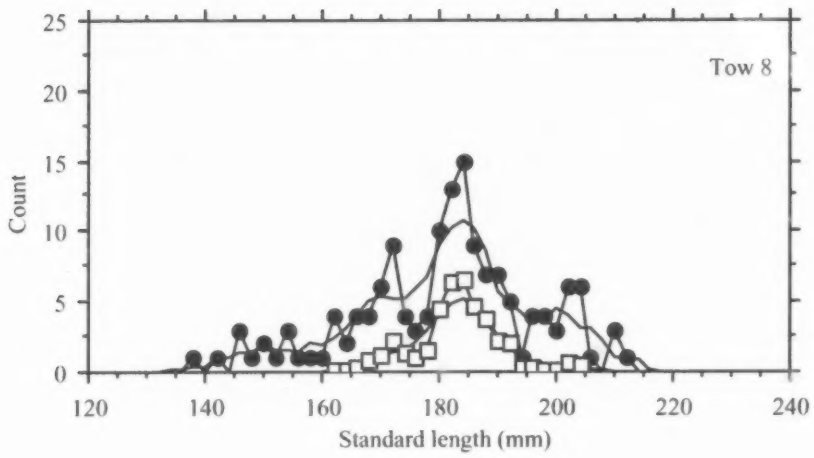
Appendix Figure 3.2 cont'd.



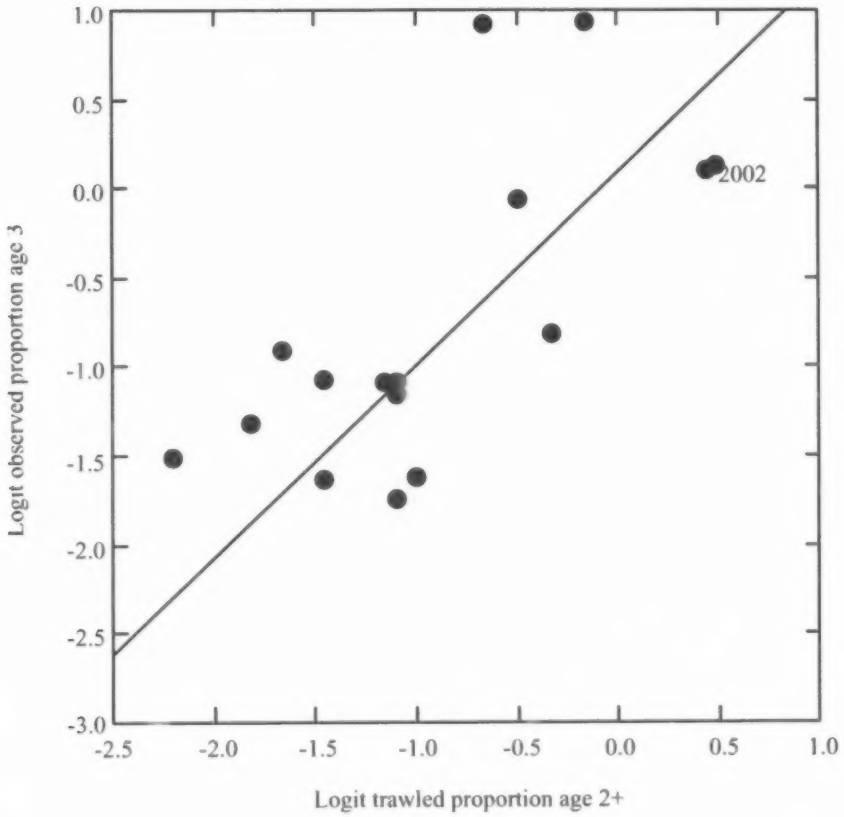
Appendix Figure 3.3. Length-frequency histograms for herring trawled during the 2002 offshore herring survey. Open squares indicate fish presumed to be age 2+.



Appendix Figure. 3.3 cont'd.



Appendix Figure 3.3 cont'd.



Appendix Figure 3.4. Scatterplot of logit observed proportion age 3 against logit trawled proportion age 2+. Line is GMR regression. 2002 – forecasted and observed data pair for 2002 fishing season.